AMERT SITE INVESTIGATION

VOLUME I

Prepared for:

Whirlpool
CORPORATION

Clyde, Ohio

Prepared by:

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Austin, Texas

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1.0

1.0 EXECUTIVE SUMMARY

The Amert Landfill was operated by Whirlpool between 1970 and 1976 as a disposal site for non-hazardous metal-finishing wastes and porcelain solids. The site is located approximately one mile southwest of the factory, in an agricultural area on leased land. The site was developed by excavation of a shallow (less than 5 feet deep), 4-acre unlined pit, construction of a low levee or berm around the excavation, and installation of a truck-unloading sluice. A small "overflow" pit of similar construction was built on the northwest side of the landfill. Wastes were placed by draining solids-laden slurry from tank trucks into the landfill and allowing the slurry to dry.

Whirlpool noted vegetation distress as early as 1975 and began a program of sampling and analysis that has continued on a regular basis up to the present. Whirlpool submitted periodic reports to Ohio EPA (OEPA) on the results of these analyses. The landfill was closed in 1977, following a plan agreed upon by the OEPA in January 1977, by placement of a cap consisting of a thickness of approximately one foot of clay overlain by one foot of sand. A ground-water interceptor trench was constructed in 1978 along the south and east sides of the landfill. The trench contains a perforated pipe and coarse rock. Ground water intercepted by the trench flows by gravity in a buried pipe to an outlet on the slope to the north.

The landfill is located in an area that is surrounded by wooded fencerows, small wooded tracts, and agricultural land. Geologically, the site is situated on an east-west trending ancient beach ridge sand deposit associated with a predecessor to Lake Erie. The low "ridge" is easily traceable on topographic maps throughout much of northern Ohio by the gentle north-facing slope that descends to the relatively flat lake-plain surface. The lake-plain surface is approximately 20 to 25 feet lower than the ridge crest.

Stratigraphic borings indicate that the beach ridge upon which the landfill is located is underlain by sand approximately 20 feet thick. The sand thins northward, and essentially disappears at the base of the slope, which is near the southern limit of fields usually planted with row crops or in hay pasture. This elongate sand unit extends southward for a distance of perhaps one mile, but extends for many miles to the east and west. The sand body is underlain by dense, fine-grained, apparently unfractured clayey silt and silty clay till and lacustrine deposits 50 feet thick. Bedrock occurs at a depth of approximately 70 feet.

All water wells of record in the area surrounding the site tap the bedrock aquifer, which is composed of lower Devonian and upper Silurian carbonate rock. The wells are used for domestic supplies. These wells have been sampled by Whirlpool and the results have been reported to OEPA and the Sandusky County Health Department. The concentrations of the constituents analyzed were at background levels in all samples. The nearest communities are Fremont, Clyde, and Bellvue, and they obtain their municipal water supplies from surface-water sources.

Core samples of the landfilled waste materials (waste) were analyzed for the substances listed in 40 CFR 264 Appendix IX. No hazardous organic materials were detected in the waste, including volatile and extractable organic compounds, pesticides, herbicides, and PCBs. The waste materials were found to contain metals and other trace elements as well as lubricating oils. Environmental samples were collected and analyzed for the constituents detected in the waste. The environmental samples included ground waters from thirteen monitor wells and one domestic water well, three samples of surface water, nine sediment cores, and 17 samples of shallow soils.

The results of the analyses indicate that the landfill has released limited amounts of waste constituents to the ground water. The materials which have migrated northward toward the affected crop area include boron, sodium, magnesium, potassium, sulfate, and fluoride. At the concentrations detected, none of these materials appears to be capable of affecting human or animal health. However, boron appears to be causing some distress to some crops north of the landfill.

The patterns of concentrations of some other substances indicate that they may have been released, but if so, they have migrated only a very short distance due to geochemical constraints on their mobility. These include phosphorus, nickel, and possibly arsenic.

The ground water in the shallow sandy aquifer flows northward at a rate of approximately 100 feet per year. Agricultural land is located approximately 700 feet north of the landfill. Subsurface migration is limited, however, by termination of the shallow water-bearing sand at that location. Small tongues or lobes of the shallow sand apparently terminate beneath areas in the southern part of the field where crop growth is affected. Ground-water flow through these sands has caused concentrations of boron in the soil in these areas to increase to levels where crop growth has been affected. The size of the affected area appears to depend on the boron tolerance of the particular crop planted in the field. When a more boron-sensitive crop is planted, (e.g., soybeans) the area of poor growth is somewhat larger than if a slightly more boron-tolerant crop is present (e.g., corn).

Since the shallow sand does not continue northward, the land area which could be contacted by waste constituents in ground water is limited to approximately one-quarter to one-half acre and is not likely to become significantly enlarged. Boron is also present in spring discharge water, which can move into the gentle, vegetated swale that forms a surface drainageway leading northward through a hay pasture. The surface drainage moves northward for several hundred feet and then trends eastward into the field mentioned above. In the hay pasture, more boron-tolerant plants have begun to grow within the drainageway. Where the drainageway enters the crop field, the soybeans are affected in a limited area of approximately 2,000 ft^2.

Samples from private wells tapping the bedrock aquifer indicate that local ground-water supplies have not been affected and do not appear to be at risk. Samples of water from the bedrock monitoring well installed at the site have not been affected by the waste constituents. The silty-clayey till and lacustrine deposits that underlie the landfill are apparently providing an excellent barrier to downward migration.

Since there is no reasonable pathway through which human ingestion of the water can occur, the migration of soluble boron does not appear to be capable of causing harm to human health or fauna. The recommended maximum level of boron in livestock diets is 100 mg/L (U.S. Dept. Interior, 1990). All concentrations of boron measured in surface water sample during this study were below this "guideline". Additionally, surface water containing boron is not present in any significant quantity except during periods when substantial rainfall increases the discharge of both the natural groundwater system and the artificial drain system. During these events dissolved constituents would be most dilute, therefore, any ingestion by livestock would be lower concentrations.

The best and simplest resolution of the crop growth problems appears to be an alteration of cropping patterns and substitution of more boron-tolerant pasture plantings in the areas where boron levels in soil affect the more sensitive row crops. The current landfill configuration does not appear to be causing environmental problems other than these effects on plants in limited areas. Vegetation growing on the landfill cap and trees and shrubs in the surrounding woodlands appear to be essentially unaffected.

2.0

2.0 INTRODUCTION

This report presents the results of an investigation of an off-site landfill performed by IT Corporation (IT) for Whirlpool Corporation (Whirlpool). This landfill, located near Clyde, Ohio, was used by Whirlpool to dispose of certain industrial wastes generated at Whirlpool's appliance factory in Clyde. The IT site investigation of this site, called the "Amert Site", was conducted in late 1989 and 1990. The following paragraphs describe background information on the site and the general physiographic setting. Section 3.0 of this report describes previous work on site soil and water conditions that have been performed. An Executive Summary of the results of the IT investigation appears in Section 1.0. In the main body of the report, the field investigation is described, including health and safety and quality assurance procedures, the regional hydrogeology of the area is outlined, and the results of the field investigation are described and summarized.

2.1 BACKGROUND

The Amert site is located about one mile southwest of the Whirlpool factory in Clyde, Ohio. The site is a solid waste landfill that was utilized by the plant between the years of 1970 and 1976. The landfill covers approximately 4.5 acres of a 16-acre tract of leased land located about 2,000 feet off of Maple Street, also called County Road 179 (Figure 2-1). Whirlpool leased this land beginning in May 1970.

Design drawings for this site were submitted to the Ohio Department of Health and the drawings were approved for Industrial Waste Disposal in June 16, 1970. Construction basically consisted of an excavation approximately three feet deep, stockpiling of the cover materials, construction of low retaining berms up to approximately two feet above existing grade around the periphery of the site, and placement of the landfill wastes. Two overflow pits, consisting of about 0.5 acres each and of similar construction, were planned to be sited just north of the landfill. However, only the west overflow pit was constructed and was utilized on rare occasions. Wastes that were placed in the landfill consisted of non-hazardous metal hydroxide sludges from treatment of metal-finishing wastes, and porcelain solids, generated by manufacturing processes at the appliance factory. The wastes were transported to the site from the plant as slurry or sludge in tanker trucks, and the material was discharged to the landfill pit. This method of disposal of these wastes was discontinued in 1976 after installation of a vacuum filter for treatment of sludge in Whirlpool's waste treatment plant.

Vegetation growth problems were recognized by Whirlpool in 1975, at about the time the site was closed. Whirlpool began collecting samples of plant leaves and soils from areas of distressed vegetation and areas of healthy vegetation in Fall of 1975. Whirlpool also began collecting samples of surface waters and ground waters at that time. Boron was identified as a constituent of concern by this work. Many of these and later samples were split with OEPA, and Whirlpool's analytical results were submitted to OEPA.

In December 1976, Whirlpool met with OEPA representatives to describe the history of the site, Whirlpool's sampling and analysis program, the conclusion that soluble boron was causing a problem with vegetation in some areas, and Whirlpool's plans to close the site. OEPA made comments on the closure plan in January 1977.

The landfill was closed according to a plan outlined by OEPA in a document dated January 21, 1977. The site was capped with a one-foot thickness of clay overlain by one foot of vegetated topsoils. After the cap and cover was constructed, a subsurface ground-water interceptor drain was installed in 1978 along the south and east sides of the unit, approximately down the center lines of the former containment berms. The drain consists of trenches filled with gravel and perforated pipe; the trenches were excavated to several feet below the bottom of the landfill. The trench system has a buried discharge pipe which leads to the north of the site. The pipe discharges by gravity to the ground surface on the slope to the north of the site. The site is presently capped and vegetated.

Whirlpool continued to work with OEPA during the late 1970s and the 1980s to monitor potential effects of the landfill on the surrounding land. Periodic reports on the results of analyses of soils and waters have been made by

Whirlpool to OEPA. After additional complaints of vegetation distress by a landowner located to the north of the site, the OEPA informed Whirlpool that the site was placed on the CERCLIS list (January 28, 1988). OEPA suggested that Whirlpool install monitoring wells and make soil borings to determine the hydrogeology of the site, whether leached materials could be affecting crops, and whether the landfill could be affecting local ground-water resources.

2.2 PHYSIOGRAPHY

The site is located approximately one mile southwest of Clyde, Ohio. The surrounding area is characterized by the relatively flat topography of the broad lake plain section of the Central Lowlands Province. The flat topography is interrupted by long, sinuous, somewhat subdued ridges which are associated with ancient shorelines of a glacial lake (Figure 2-1). The low ridges may be several thousand feet wide. The landfill is located on one of these ridges, a low, broad, northeast-trending feature. The area of affected crops lies just to the north of this rise at an elevation which is more than 20 feet lower than the present upper surface of the landfill cap. The natural topography of the crest of the ridge is slightly undulating, and marked by small rises and depressions. Much of the land on the ridge is used locally for orchards and pasture, whereas most of the land not located upon the ridge is utilized for row crops and pasture.

The soil types are slightly different on the ridge compared to those not located on the ridge. The farmland located off of the ridge is characterized by the Hoytville-Nappanee Soil Association which consists of level, more poorly drained, generally fine-grained soils that were typically formed on glacial till or lake-bottom sediments (SCS, 1987). In contrast, the soils which cap the ridges belong to the Spinks-Rimer-Kibbie Association which consists of gently sloping or nearly level, generally well drained, more coarse textured soils that formed on sandy lacustrine shoreline sediments (SCS, 1987). The present topography and soil characteristics are closely related to the underlying geology, as described in Section 6.0.

The mean annual rainfall in this area is approximately 33 inches. Nearly 60 percent of this typically falls in April through September. Annual temperatures generally range from an average of approximately 27°F in the winter (average daily minimum of 19°F) to an average of 71° in the summer (average daily maximum of 82°F).

The site drains northward into unnamed tributaries of Raccoon Creek. Raccoon Creek flows to Sandusky Bay on Lake Erie.

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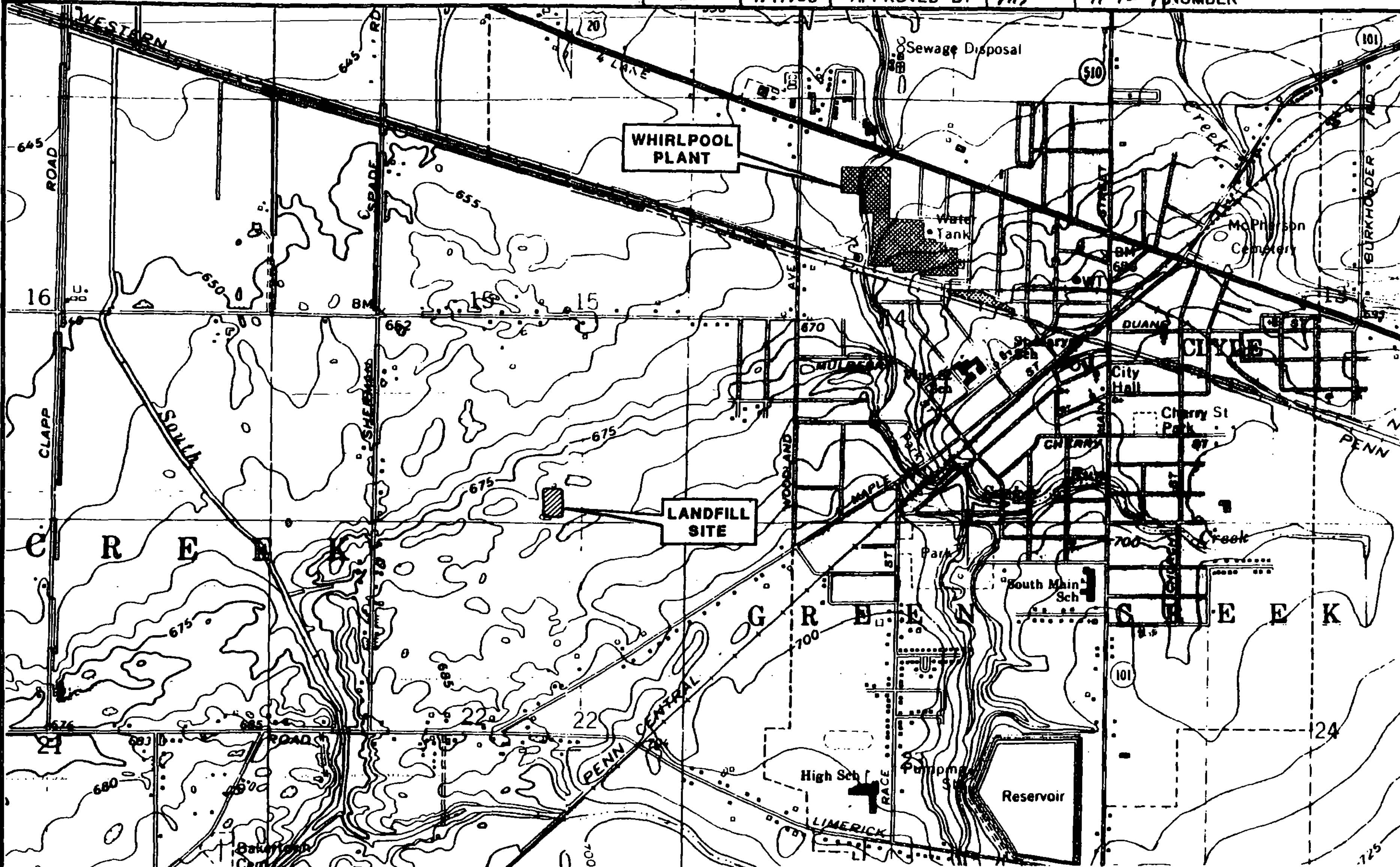

Map Source: USGS 7.5' Quad Sheets CLYDE, OHIO 1969; FREMONT EAST, OHIO 1980.

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FEET

FIGURE 2-1
SITE LOCATION MAP
AMERT SITE INVESTIGATION

PREPARED FOR
WHIRLPOOL CORPORATION
CLYDE, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

3.0 PREVIOUS WORK

Whirlpool began a program of sampling of soils, surface waters, and ground waters in the vicinity of the Amert Landfill site and ground water in the vicinity of the Amert Landfill site beginning in 1975, before the facility was closed and capped. The sampling was initiated in response to observations of vegetation distress near the landfill. Two wells were sampled regularly. These included a hand-dug well and a PVC monitoring well installed near the hand-dug well. Both of these wells are located in the area north of the landfill. Sampling has continued at more-or-less regular intervals, and regular reports have been submitted to the Ohio EPA.

In response to concerns that poor growth of crops in a corner of an adjacent field were due to the landfill, Whirlpool retained Battelle Laboratories in 1988 to conduct a preliminary evaluation of potential effects on plant and animal health that could be caused by landfill leachate. Battelle collected samples of soils and surface waters, and ground waters from a shallow dug well at the site. Battelle compiled the analyses of these samples and the records of the analyses of other ground-water samples that had previously been collected and analyzed by Whirlpool in the vicinity of the site, and by the U.S. Geological Survey (USGS) in the general area around Clyde. Battelle also performed laboratory studies of the effects of boron on seed germination.

The results of the Battelle studies were reported in two documents (Battelle, 1989a; Battelle, 1989b). The soil sampling and seed germination studies (Battelle, 1989a) found that elevated levels of boron and sodium were present in cropland to the north of the Amert site, principally in two areas in the southern part of a corn field and in an area where a surface drainage course enters this field. In the seed germination tests, 100 percent of the seeds germinated in the soils that were affected by elevated levels of boron. However, the later growth of the seedlings was not studied.

The health significance study (Battelle, 1989b) reported the concentrations measured by Battelle in ground water of boron, chromium, copper, nickel, manganese, and zinc, as well as the common major ionic species alkalinity, chloride, sulfate, and sodium. These samples include both samples of surface water and ground water collected at the site by Whirlpool and samples collected by the USGS from area wells completed in the bedrock aquifer. They also reported the concentrations of boron, chromium, copper, nickel, manganese, chloride, and sodium in soils Battelle collected in the fields to the north of the landfill.

The report found that levels of boron, chloride, manganese, nickel, sodium, and zinc were elevated in shallow ground water near the site, compared to typical levels in water from domestic bedrock wells near the site, and compared to levels in water from the Clyde-area bedrock wells sampled by the USGS. The potential health effects of ingestion of sustained high levels each of these compounds were reviewed. No pathways for such exposure were identified.

Information on the degree of bioaccumulation in plants, meat, and milk was reviewed by Battelle for boron, chromium, copper, manganese, nickel, sodium, zinc, and chloride (as zinc chloride). All of these compounds tend to accumulate in plants to some degree when the compounds are available in soils. The highest feed-to-animal product transfer factor was found to occur with sodium.

In the IT study, many of the previously sampled locations were resampled and the samples were analyzed for the same constituents. In addition, the new samples were analyzed for all the compounds listed in 40 CFR 264 Appendix IX that were found to be present in samples of the landfill waste materials at significant concentrations. Concentrations of constituents in the soil samples from affected areas were compared to concentrations in samples other soil from other areas, which are believed to contain background concentrations of the constituents. The sampling procedures are described in Section 5.0.

4.0

4.0 REGIONAL HYDROGEOLOGY

The Amert site is located in Green Creek Township of eastern Sandusky County, two miles southwest of the town of Clyde, Ohio. The site is located in the Raccoon Creek Basin which runs through Northeast Sandusky County and discharges to Sandusky Bay on Lake Erie. The area is one of generally flat topography with elevations ranging from approximately 665 to 690 feet above sea level (Figure 2-1).

4.1 REGIONAL GEOLOGY

Sandusky County is located in western north-central Ohio near the axis of a regional structural flexure in the sedimentary bedrock. This feature, known as the Findlay Arch or the Cincinnati Anticline, forms the western border of the Appalachian Basin, which is located to the east of this area. Total thickness of the sedimentary rock column is approximately 3,000 feet. The sedimentary rocks are underlain by igneous rock basement of low permeability.

The uppermost bedrock unit is part of a group of Silurian and Devonian carbonates (limestone and dolomite) and evaporites (gypsum, anhydrite, and salt) (Figure 4-1). Deposition of these sedimentary rocks was affected by local variations in water depths, wave energy and water chemistry as well as structural features. The result is a group of rock units with considerable areal variability in porosity and permeability due to the differences in lithology. Thickness of the carbonate/evaporite rocks near Clyde is approximately 400 feet. These units are commonly are grouped together and referred to locally by water-well drillers as the "Big Lime" (Figure 4-2). However, in Sandusky county, the "Big Lime" can be differentiated into the Lockport Dolomite, Greenfield Dolomite, Tymochtee Dolomite, the Raisin River Dolomite and undifferentiated Lower Devonian Rocks. The uppermost bedrock unit in the Clyde area has been identified as the Raisin River Dolomite (ODNR, 1970).

Overlying the irregular, eroded surface of the Silurian and Devonian Limestones are Pleistocene glacial deposits ranging in thickness from approximately 40 to

80 feet. These glacial deposits are primarily clay- or silt-rich tills with thin interbedded sand or silt layers. Also associated with the glacial materials are two types of elongate, linear deposits of more coarse-grained sand and gravel.

The first type is stream-laid sediment which is primarily found in the lower part of the glacial deposits, just above bedrock. One of these ancient channel deposits is a north/south trending feature located approximately two miles west of the landfill in the area near Green Creek (ODNR, 1970).

In addition, elongate, linear, generally east-west trending sand deposits exist in the site area and form water-bearing entities that lie just below the land surface. These ancient shoreline deposits of a glacial lake that formed before Lake Erie, called Lake Warren, generally overlie offshore lacustrine muds or ground moraine till (Stout and others, 1943). The locations of these beach ridges is ordinarily conspicuous on topographic maps, as they are generally elevated above the surrounding lake plain surface. The Amert landfill is located on one of these beach ridges. Figure 4-3 illustrates the distribution of glacial deposits throughout Ohio.

4.2 GROUND WATER

The principal aquifer (Big Lime) in eastern Sandusky county is formed by carbonate rocks of Upper Silurian and Lower Devonian age, the top of which is in this area, at depths ranging from 40 to 80 feet below ground surface. Most of the water wells in eastern Sandusky county are completed in bedrock, and usable quantities of water are widely available from the upper weathered part of the bedrock, regardless of the particular geologic formation present.

Most of the till and lake-bottom deposits are poor producers of ground water. However, the shallow-lacustrine shoreline sands form minor aquifers from which small supplies of water could be obtained. Due to the availability of water from the bedrock aquifer, these sands are not utilized as a water source in this area. Supplies from this source are subject to significant reduction during drought conditions, and they are vulnerable to contamination from septic tanks and agricultural practices.

Ground water obtained from the Big Lime in eastern Sandusky county is somewhat mineralized due to the occurrence of gypsum in the aquifer rock. Total dissolved solids concentration in this area is commonly greater than 1,000 ppm. The ground water is considered to be "hard", i.e., containing relatively high concentrations of calcium and magnesium, and does not meet Secondary Drinking Water Standards, which require sulfate concentrations to be less than 250 mg/L.

A survey of domestic water wells within one half mile of the Amert site was performed by IT personnel. The wells are shown on Figure 4-4. Records were obtained from The Ohio Department of Natural Resources (ODNR) to determine which water bearing zones were tapped by local wells. All of the wells of record in the immediate area around the site are completed in the "Big Lime". Some residents obtain water from the public water supply system of Clyde, where available. Table 4-1 lists representative wells in the area and pertinent stratigraphic and hydrologic information. Photo copies of the ODNR State Log and Drilling Report are contained in Appendix C. The water supplies of the towns of Clyde, Fremont and Bellvue are derived from surface sources.

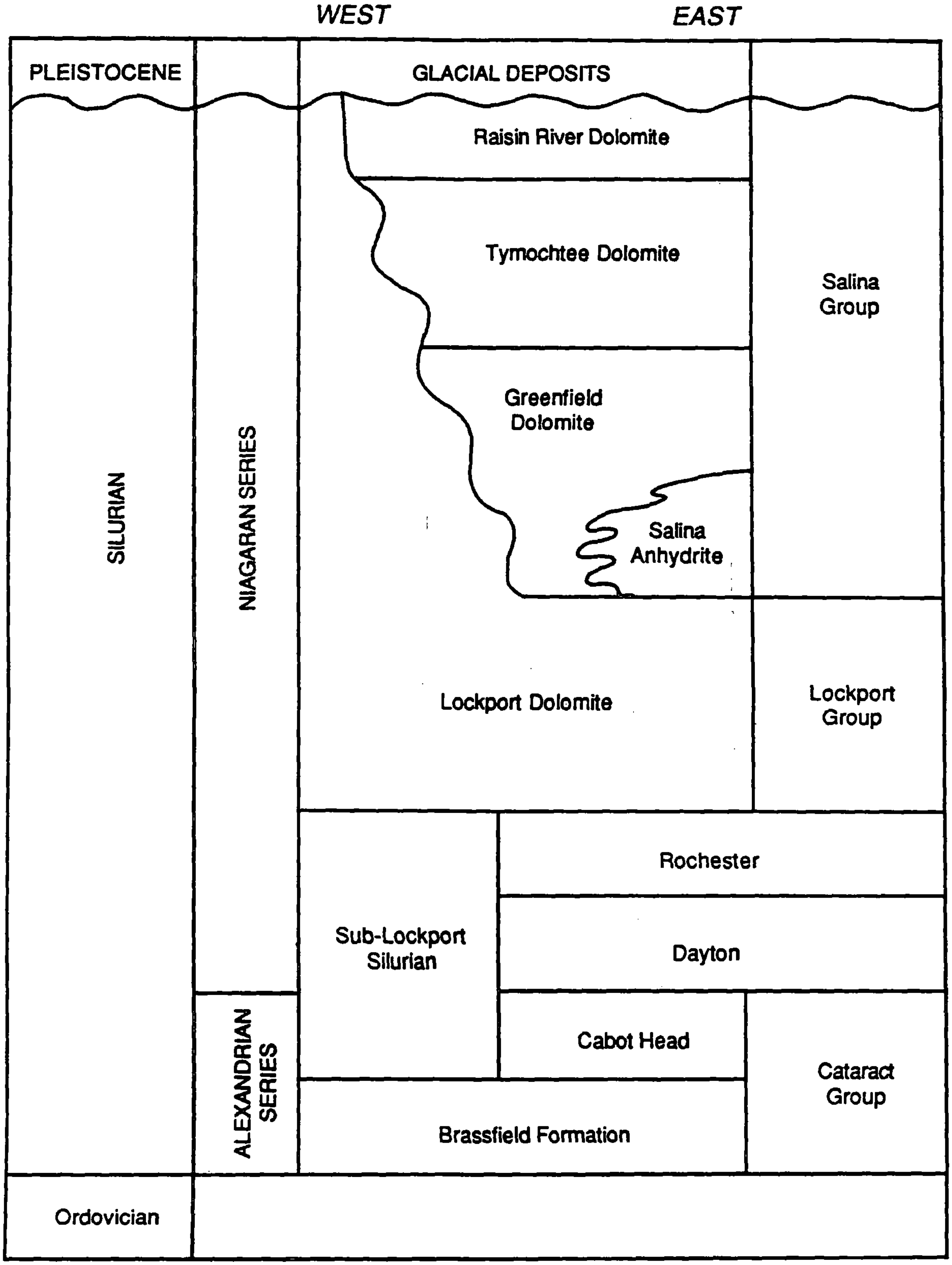

FIGURE 4-1

STRATIGRAPHIC COLUMN
FRESH-WATER BEARING UNITS IN
THE AREA OF CLYDE, OHIO

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CLYDE, OHIO

DRAWING NUMBER 446493-A98

APPRV. BY

PROJ. CHK

DRAFT CHK

DRAFT BY RPS 11/12/90

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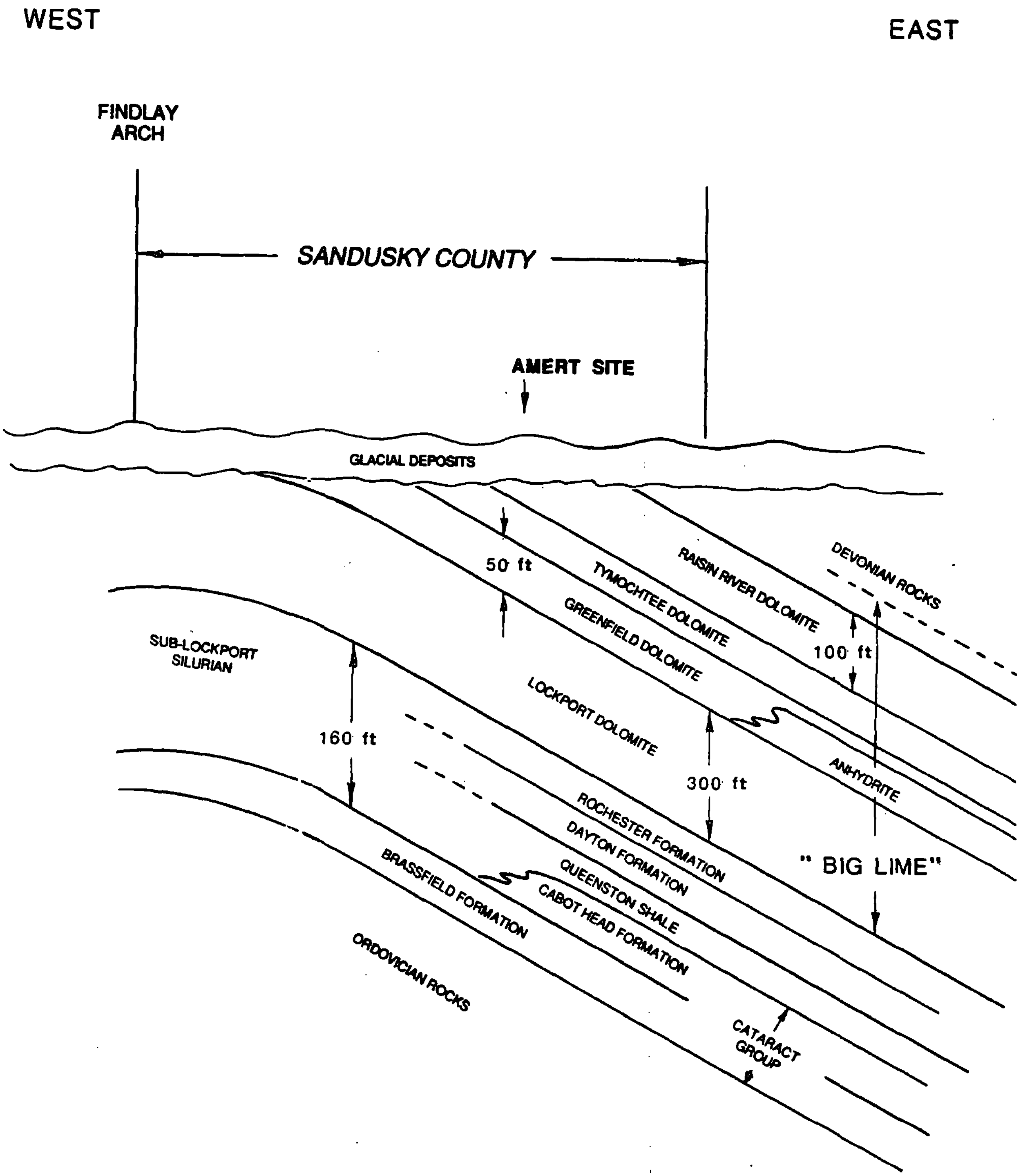

FIGURE 4-2
SCHEMATIC REGIONAL GEOLOGIC CROSS SECTION
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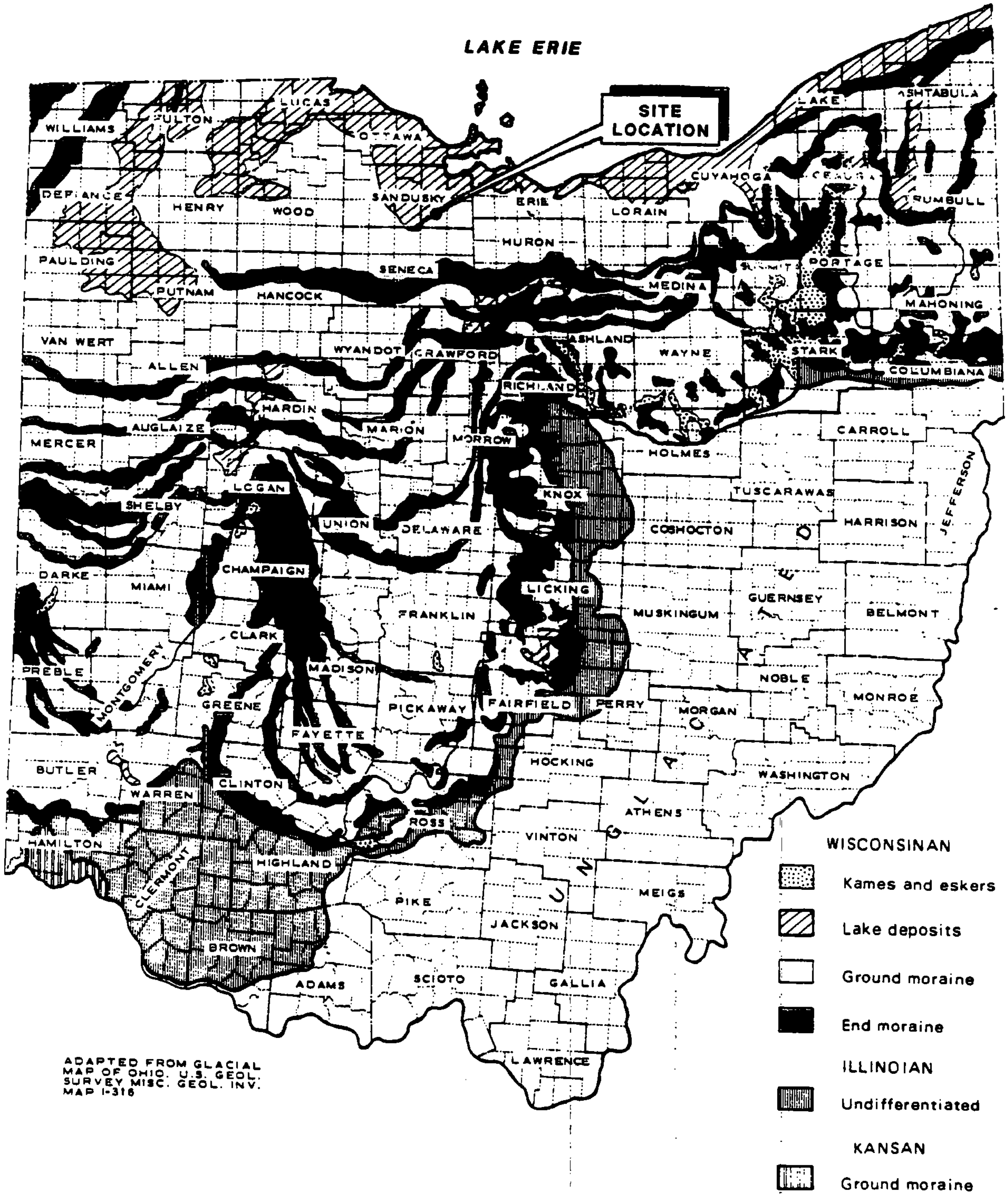

Map Source: State of Ohio Department of Natural Resources, Division of Geological Survey

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FIGURE 4-3
MAP OF GLACIAL DEPOSITS IN OHIO

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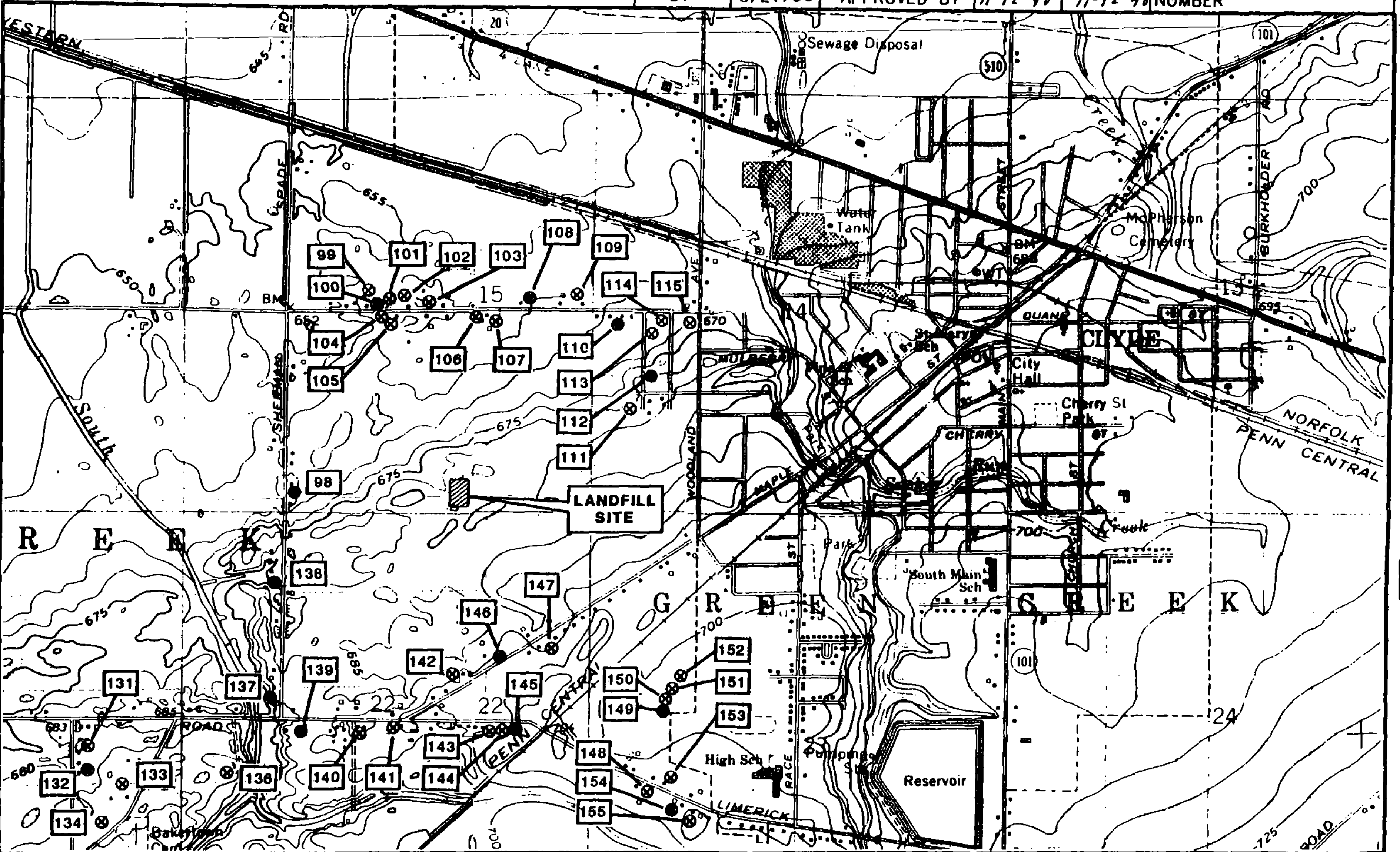

Map Source: USGS 7.5' Quad Sheets CLYDE, OHIO 1969; FREMONT EAST, OHIO 1980.
Data Source: Records of Ohio Department of Natural Resources, Columbus, Ohio.

EXPLANATION

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⊗ 106 WATER WELL OF PUBLIC RECORD (APPENDIX C)

● 108 WELL OF PUBLIC RECORD WITH DETAILS IN TABLE 4-1

FIGURE 4-4
LOCATIONS OF WATER WELLS OF PUBLIC RECORD IN THE VICINITY OF AMERT LANDFILL SITE

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5.0

5.0 FIELD INVESTIGATION

The field drilling at the Amert Site was conducted during the period from November 14 to December 6, 1989. All activities conducted during the field investigation program were performed in accordance with a Work Plan prepared by IT (Appendix F). The Work Plan contains a complete Quality Assurance Project Plan and Health and Safety Plan.

The field investigation consisted of two separate field drilling efforts. In the first, two "deep" stratigraphic borings were advanced into bedrock, and one of these borings was converted to a bedrock monitoring well (Figure 5-1). Three borings were advanced into waste fill materials in order to collect samples for chemical analysis. After the waste samples had been analyzed, a list of analytical parameters for the second field effort was established. However, to save time, it was decided to proceed with the second phase of drilling before complete analytical results were available. Therefore, samples were collected in each of the appropriate sample containers so that correctly sampled and preserved material would be available for analysis of any of the parameters that might be found in the waste. However, many of these compounds or elements were not found in the waste, and the corresponding sample portions were not needed.

In the second phase, twelve shallow monitoring wells were installed, and samples of ground waters, surface waters, and soils were collected. During a second sampling event in April 1990, additional water samples were collected from monitoring wells, soils, and surface waters in order to reconfirm and/or augment earlier analyses. An additional set of soil samples was collected in August 1990 in order to reanalyze for "available" for boron by the "hot-water" leach method (American Society of Agronomy, 1982). Locations of wells, borings, and all other sampling points are shown on Figure 5-1. A summary of wells and borings appears in Table 5-1. A summary of all environmental samples collected appears in Table 5-2.

All work was performed in accordance with applicable regulations and guidelines, including those of the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) and 29 CFR 1910.

The following sections describe the field drilling and sampling methods. A discussion of the findings and results of the field investigation is provided in Section 6.0. Boring logs describing the material encountered during drilling and sampling procedures are in Appendix A. Copies of laboratory reports are in Appendix D.

5.1 WASTE BORINGS

Waste materials were sampled and analyzed for the suite of waste constituents listed in 40 CFR 264, Appendix IX (Table 5-3). This procedure was used to determine the appropriate parameter list to be applied in the subsequent analysis of samples of subsurface soils, surface soils, ground waters and surface waters. Table 5-3 provides a summary of the analytical parameters and the corresponding sample bottle sets, preservation methods, and analytical methods used for the analysis of waste samples. A summary of sample handling procedures is provided in Section 5.7. Section 6.3 describes the results of the analyses.

Waste borings were made at three locations (WB-1, WB-2 and WB-3) within the landfill (Figure 5-1). The borings were advanced to a depth of 8 to 12 feet below ground level (BGL) using 8-inch O.D. continuous-flight, hollow-stem augers. Core samples were recovered of both the waste materials and the materials above and below the waste.

Samples collected from the uppermost part of the boring were used for geotechnical evaluation of the cover material. The geotechnical samples were placed in 1-liter glass soil sample jars. The test results for the cover samples are discussed in Section 6.4.

Core samples of the waste materials were recovered using both a 2-inch O.D. by 2-foot split-spoon sampler and a 3-inch O.D. by 5-foot split-barrel sampler located within the lead auger flight. No fluids were added to the boreholes during drilling. The cores were described and sampled for chemical analysis.

The waste-boring core was screened in the field with a photoionization detector (PID) to determine if organic vapors were present. PID measurements were made along the length of each core at a minimum interval of one foot. Using one half of the split barrel as a core holder, the core samples were covered with plastic sheeting and immediately screened for organic vapors. The core samples were broken open with a clean steel knife to expose a fresh soil face for PID screening. No readings above background level were obtained during any of the screening procedures. A number of samples were subjected to head-space sampling (placement of the sample in a sealed jar or closeable plastic bag for 5 minutes before measurement) and these also were found to be free of detectable organic vapors. However, samples of the waste materials were collected for laboratory volatiles analysis.

Samples cut from the cores were placed in the appropriate sample containers (Table 5-3). The waste materials exhibited distinct layering, with each layer having a slightly different color or consistency compared to layers above and below. Three samples were collected from each borehole, at three different depths. Each of the three samples, however, consists of material from a number of individual thin fill layers near the target depth. This is true of both volatile and non-volatile samples. Soils to be analyzed for volatile organics were collected first and were handled in a manner that would minimize loss of potential volatile organic contaminants. All bottles were sealed with teflon-lined caps. All of the waste fill samples were composited into a single sample, as described in Section 5.7.

All soil samples were inspected and documented in a lithologic log by the on-site IT field geologist, using the Unified Soil Classification System. Boring logs summarizing the material encountered and sampled are provided in Appendix A. Upon completion of each waste boring, the borehole was grouted from total depth to ground surface using a cement/bentonite slurry.

Collection of natural sediment samples and completion of the sediment-sampling borings as monitoring wells is described in Section 5.2.

5.2 SOIL SAMPLING AND MONITORING WELL INSTALLATION

A total of thirteen monitoring wells were installed in the study area to measure the hydraulic head of the ground water, determine hydraulic properties of the water-bearing sediments, and provide for the collection of water samples for chemical analysis. Twelve wells were screened in a shallow sand unit, which is the uppermost water-bearing unit, and one well was completed in the "Big Lime" bedrock aquifer. Locations of wells are shown in Figure 5-1. Figure 5-2 provides a summary of monitoring well completion information. Well completion diagrams are provided in Appendix A. Hydrologic conditions in the study area are discussed in Section 6.2.

Three monitoring wells (MW-2, MW-3, and MW-6) were completed near sampled companion borings. As a result, borings for MW-2, MW-3 and MW-6 were not sampled and the logs for these wells are the same as those for the upper part of neighboring wells MW-1, MW-4, and MW-7, respectively. Monitoring well locations are shown on Figure 5-1.

Undisturbed samples of subsurface soil/sediments were collected from eleven locations (SB-1,SB-2, MW-1, MW-4, MW-5, MW-7, MW-8, MW-9, MW-10, MW-11, [SB-3] and MW-12) (Figure 5-1). The samples were used to establish stratigraphy, and one sample from above the water table at each location was analyzed for waste constituents. All soil samples were inspected and documented on a lithologic log by the on-site IT field geologist, using the Unified Soil Classification System. Ten of the eleven borings subsequently were completed as ground-water monitoring wells. SB-2 was drilled and sampled for stratigraphic information only. SB-3 was grouted from total depth to ground surface with a cement/bentonite slurry and MW-11 was completed in a new boring adjacent to SB-3. Other monitoring well borings (MW-2, MW-3, and MW-6) were not sampled because they were located adjacent to a sampled boring.

5.2.1 Shallow Monitoring Wells

The borings used for installation of monitoring wells MW-1, MW-4, MW-5, MW-7, MW-8, MW-9, MW-10, MW-11(SB-3) and MW-12 were advanced to total depth using 8-inch O.D. continuous-flight, hollow-stem augers. Samples were collected for chemical analysis and lithologic description using both a 2-inch O.D. by 2-foot split-spoon sampler and a 3-inch O.D. by 5-foot split-barrel sampler located within the lead auger flight. No fluids were added to the borehole during the drilling process.

The soil core samples obtained from borings MW-1, MW-4, MW-5, MW-7, MW-8, MW-9, MW-10, MW-11(SB-3) and MW-12 to be used for chemical analysis were collected in the vadose zone above the water table (generally 1 to 4 feet in depth). Samples from below the water table were described in the logs but not saved for chemical analysis. However, the entire continuous soil/sediment core was screened in the field with a PID, using the procedure described in Section 5.1. As mentioned previously, soil samples from above the water table were analyzed for a list of parameters based on the laboratory results of analysis of the waste materials (Table 5-4). The samples from each boring which were collected for chemical analysis were placed in 500 ml and 125 ml clear-glass soils jars. All jars were sealed with teflon-lined lids. Sample handling is described in Section 5.7.

The coreholes used for collecting sediment samples were reamed using 10-inch O.D. continuous-flight hollow-stem augers. Borings for wells installed without soil sampling (MW-1, MW-4, and MW-7) were drilled with 10-inch O.D. augers. Well screen and casing were installed through the center of the 10-inch O.D. augers. Each well screen was constructed of 4-inch I.D., 0.010-inch mill slotted, flush-threaded, schedule 40 PVC. The well casing was constructed of 4-inch I.D., flush-threaded, schedule 40 PVC. Threaded joints were used to connect the well materials; no solvent welding of screen or casing joints was done.

A #7 (20-40 grade) silica sand pack was poured through the augers to a level of approximately 1 foot above the top of the screen. An annular seal consisting of 3/8 inch diameter bentonite pellets and/or granulated bentonite was placed above the sand pack. The bentonite seal was poured to an approximate (non-hydrated) thickness of two to three feet. The remainder of the borehole was grouted to ground surface with a cement/bentonite slurry. All wells were completed with a 3-foot by 3-foot by 6-inch thick concrete pad to direct surface water flow away from the wellhead. Each well was equipped with a dedicated bailer hung under the well cap. Well completion diagrams are provided in Appendix A. A summary of well dimensions appears in Figure 5-2.

5.2.2 Deep Borings and Bedrock Monitoring Well

Two borings were advanced into bedrock. Deep stratigraphic boring SB-1 (Figure 5-1) was advanced initially to a depth of 30.1 feet using 8-inch O.D. continuous-flight, hollow-stem augers. Samples were collected for lithologic description using both a 2-inch O.D. by 2-foot split-spoon sampler and a 3-inch O.D. by 5-foot split-barrel sampler. The entire continuous soil/sediment core to a depth of 30.1 feet BGL was screened in the field with a PID, using the procedure described in Section 5.1. Well logs are in Appendix A.

To install the monitoring well in this boring, the 8-inch diameter auger hole was reamed with a 12-inch diameter tri-cone roller bit to a depth of 36 feet using the mud-rotary technique. An 8-inch I.D., Schedule 40 coupled and solvent-welded polyvinyl chloride (PVC) surface casing with a cement shoe was set in this hole to a depth of 35 feet. The annular space was filled to the surface with a cement/bentonite slurry using a tremie pipe. The cement/bentonite slurry was allowed to cure for approximately 20 hours prior to drilling deeper.

The lower part of SB-1 was drilled using mud-rotary techniques. Mud used during reaming of the upper part of the borehole was placed in a lined holding area, and fresh mud was made with potable water. The lower part of the borehole was then advanced using an 7-7/8-inch tri-cone roller bit. Lithologic descriptions for the lower part of stratigraphic boring SB-1 were made based on drill cuttings and geophysical logging (natural gamma radiation). Total depth of SB-1 was 94.5 feet BGL.

After the 7-7/8 inch diameter lower borehole was advanced to total depth by mud-rotary, drilling fluids were flushed from the borehole using fresh water. The well casing and screen were constructed of the same 4-inch PVC materials as those used for the shallow monitoring wells. Stainless steel centralizers were attached to the well screen and casing. Sand pack and bentonite seal were placed by slow surface dumping and sounding. The cement/bentonite grout material was emplaced with a tremie pipe. The well was equipped with a new stainless steel submersible pump set at 65 feet below ground level. A completion diagram appears on the log in Appendix A. Dimensions are summarized in Figure 5-3.

The deep stratigraphic boring SB-2 also was completed using mud-rotary drilling techniques throughout. The borehole was advanced using a 5 7/8-inch drag bit and 8-inch tri-cone roller bit, depending on drilling conditions, to a depth of 84.6 feet BGL. Core samples were obtained at minimum ten foot intervals using a 2-inch O.D. by 2-foot split-spoon sampling tool. The interval from ground surface to a depth of 10 feet was described based on cuttings. All soil samples were inspected and documented in a lithologic log by the IT field geologist, using the Unified Soil Classification System. The hole was logged with a portable natural gamma-ray logger. The hole was then grouted from total depth to the surface.

5.3 EQUIPMENT DECONTAMINATION

All augers, drill-pipe, bits, sampling tools, and related equipment were steam-cleaned with fresh water prior to drilling each borehole. The equipment was cleaned at an on-site decontamination pad made of plastic sheeting and curb material. All solid waste material produced during the field investigation was placed in steel 55-gallon drums.

All soil and surface water sample collection devices were scrubbed with detergent and rinsed with distilled water prior to sample collection. Ground-water sampling bailers consisted of new, decontaminated equipment. All shallow monitoring wells were equipped with a dedicated bailer.

5.4 GROUND-WATER SAMPLING

Ground-water samples were collected from each monitoring well (Figure 5-1). The samples were collected using methods consistent with the "RCRA Ground-Water Monitoring Technical Enforcement Guidance Document". Samples were initially collected in December, 1989. A second set of samples were collected in April, 1990. Analytical parameters are listed on Table 5-4. The sampling procedures employed in this site investigation are described below.

5.4.1 Well Development

Following well installation, and prior to the first sampling event, all monitoring wells were developed. The shallow monitoring wells were developed by bailing. Water was bailed until the amount of suspended particulate material in the produced water was minimized. Deep monitoring well SB-1 is equipped with a submersible pump, and was developed by pumping. At least 5 casing volumes of water were removed from each well.

5.4.2 Well Evacuation

Three casing volumes of water were evacuated from each of the wells prior to each sampling event. The minimum volume of water to be evacuated was calculated based on the height of standing water in the well. The amount of water in the monitoring well casing was calculated using the following formula:

$$V = (D_B - D_W)(.65)$$

where: V = well volume (gallons)
D_B = depth to bottom of well (ft)
D_W = depth to water surface (ft)

The bailer and bailer rope were not allowed to contact the ground. Where deemed appropriate, a clean plastic sheet was placed on the ground at the base of the well while the well was being purged.

5.4.3 Sampling

Each monitoring well, with the exception of deep monitoring well SB-1, was equipped with a dedicated 3-inch diameter PVC bailer. The bailer was stored by suspending it inside the well. The wells were sampled by lowering the bailer on a new polyethylene rope into the water column. Once retrieved, the water collected in the bailer was poured into the appropriate sample containers. Sample handling procedures are described in Section 5.7.

Deep monitoring well SB-1 was equipped with a submersible pump set at a depth of 65 feet. Ground-water samples were obtained at SB-1 from the pump discharge hose. Samples were collected directly into the sample bottles. Sample handling procedures are described in Section 5.7.

As mentioned previously, a full set of sample bottles (Table 5-3) was filled in anticipation of performing the complete Appendix IX analyses on these waters. After the results of the analyses of waste samples were completed and no VOAs were detected, the VOA bottles containing ground-water samples were discarded and no VOA analyses were performed on ground waters. The list of analytical parameters for ground water samples is shown on Table 5-4.

5.4.4 Water Level Measurements

The direction of ground-water flow in the shallowest water-bearing zone beneath the site was determined from ground-water level measurements made in the monitoring wells. Wellhead locations and elevations were surveyed to establish datum points at the top of each casing. Monitoring well elevation survey information is provided in Table 5-5. The depth to water from the datum point was measured in each well using an electric water-measurement line (E-line). Water levels are discussed in Section 6.2.

5.5 SURFACE WATER SAMPLING

Three surface-water samples were collected within the study area (Figure 5-1). The samples were taken by submerging a glass jar into the water and then transferring the water into appropriate sample containers. Sample handling procedures are described in Section 5.7.

5.6 SURFACE-SOIL SAMPLING

A total of seventeen (17) surface soil samples (SS-1 through SS-17) were collected within the study area (Figure 5-1). Locations SS-6 through SS-17 were sampled a second time, in August 1990, in order to analyze for boron by a second technique, a hot-water leach method (Am. Soc. of Agronomy, 1982). At two locations in the field to the north of the site, samples were taken from three different depths, up to 2.0 feet deep, at the same location. The rest of the surface soil samples were collected from a depth of approximately 6 to 12 inches. The samples were obtained using a steel shovel and transferred into the appropriate sample containers. The shovel was scrubbed with potable water between samples.

5.7 SAMPLE HANDLING PROCEDURES AND WASTE-SAMPLE COMPOSITING

This section summarizes the procedures that were used to identify, preserve, document and transport the soil and water samples collected during the field investigation program. The Quality Assurance Project Plan contained within the

Work Plan provides additional information regarding these procedures (Appendix F).

All samples were labeled to indicate the source of the sample, depth of the sampled interval (if applicable), the date and time of collection, the project name and number, and the collector's initials. Soil and water samples collected for chemical analysis were preserved on ice until delivery to the analytical laboratory. Ice chests were sealed with evidence tape.

Sample documentation included Boring Logs which describe the time, date, location and depth of boring samples, Sample Logs which describe the collection of surface-soil and surface-water samples, Chain-of-Custody forms documenting transfers of possession of water and soil samples, and Request-for-Analysis forms. Boring Logs are provided in Appendix A. Chain of Custody forms attached to the Certificate of Analysis is in Appendix D. Sample Collection Logs are provided in Appendix C. The Field Drilling/Sampling Supervisor was responsible for complete and accurate documentation of samples.

Samples of waste material, subsurface soils, ground water, surface soils and surface water collected for chemical analysis were shipped to:

IT Corporation Analytical Laboratory
5307 Industrial Oaks Blvd.
Suite 160
Austin, TX 78735
(512) 892-6684

Landfill cover samples collected for geotechnical analysis were shipped to:

IT Corporation Analytical Laboratory
5815 Middlebrook Pike
Knoxville, TN 37921
(615) 588-6401

These laboratories follow internal QA/QC procedures and conform to state and national contract lab certification programs. Normal analytical turn-around times were utilized in this investigation. Certified laboratory results are provided in Appendix D.

Waste-Sample Compositing

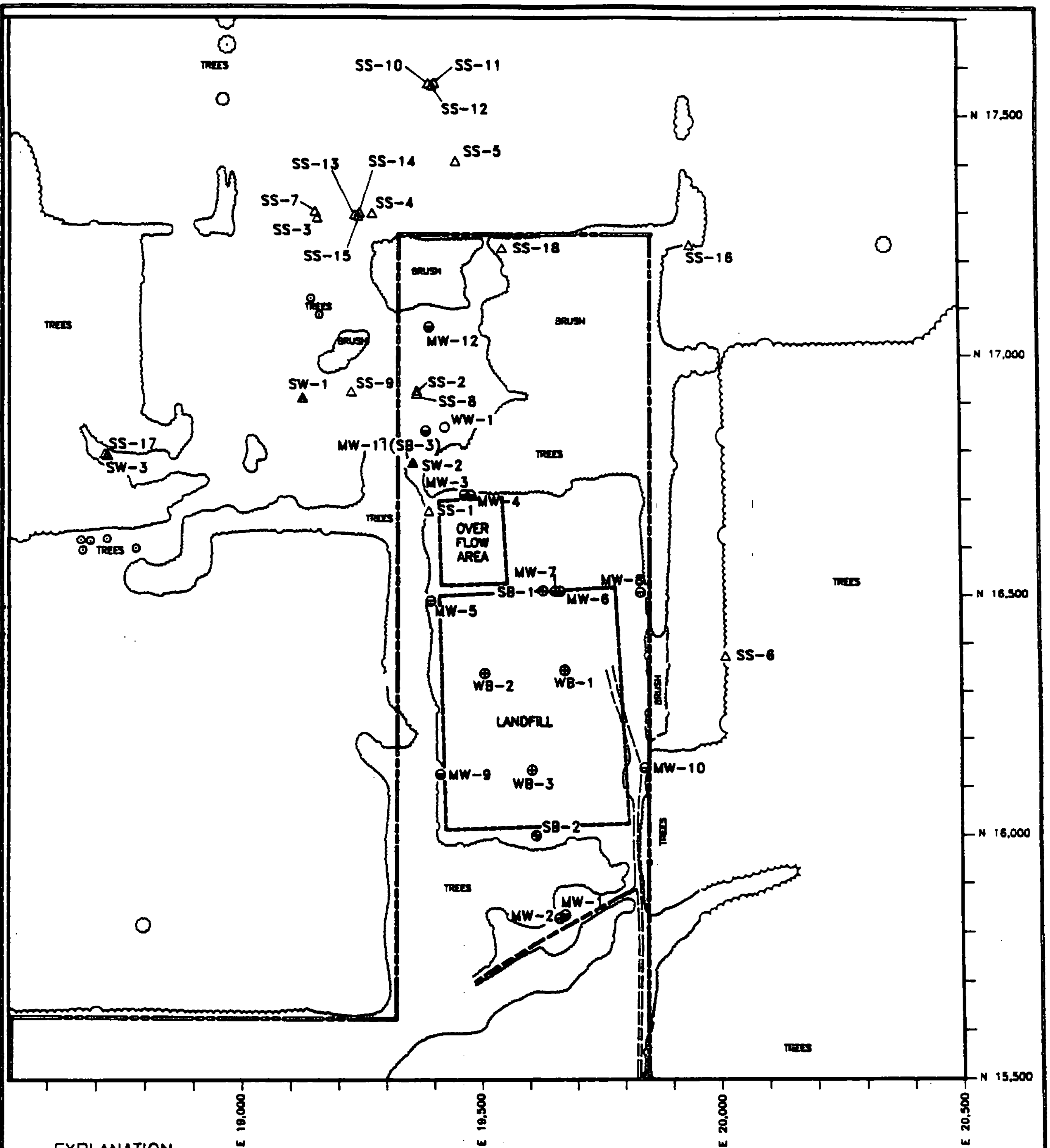
The samples of waste fill materials were composited into a single sample for Appendix IX analyses. Samples to be used for analysis of volatile organic compounds (EPA 8240) were handled separately from the samples used for the other analyses. A total of nine discrete "samples" (a "sample" includes both VOA samples and non-VOA samples) were collected at three levels in each of these waste borings (Section 5.1).

Compositing of the non-VOA samples was done by first emptying all sample jars into a stainless-steel mixing bowl. The material was thoroughly homogenized with a stirring device, and aliquots were taken for the various non-VOA analyses. For the VOA analyses, a 2-quart metal paint can was filled 1/2 full of organic-free water and weighed. The nine 125 ml VOA bottles were opened and their contents were quickly transferred to the paint can, so that the soil/waste materials would be below the water surface. The paint can was reweighed to determine the total weight of the composite sample. The can was filled to the rim with organic-free water and the lid was secured in a manner to minimize headspace. The paint can was tumbled mechanically end-over-end for 4 hours, then allowed to stand for 30 minutes in a refrigerator. The can was opened and 5 mL of liquid was drawn into each of two gas-tight syringes. The liquid was injected into a purge-and-trap vessel, and the rest of the sample preparation for VOAs was in accordance with EPA 5030.

5.8 AQUIFER CHARACTERIZATION TESTING

Aquifer tests were performed during the field investigation to determine hydrologic characteristics of the shallow aquifer present at this site. Slug tests, or rising head tests (bailer tests), were performed on MW-4, MW-5, MW-8, MW-9, and MW-10.

The slug tests were run using a data logger equipped with a strain-gauge pressure transmitter. A PVC bailer of known volume was placed into the well, and the water level was allowed to stabilize. When the water level had returned to the static level, the bailer was removed. Water levels were then monitored and recorded until the water level had returned to near its original level. Plots of water level versus time were analyzed using the Bouwer and Rice (1976) method to determine the hydraulic conductivity of the water bearing formation. The data plots are presented in Appendix B and discussed in Section 6.2.



EXPLANATION

- MONITORING WELL (MW)
- WASTE BORING (WB)
- STRATIGRAPHIC BORING (SB)
- SURFACE SEDIMENT (SS) SAMPLING LOCATION
- SURFACE WATER (SW) SAMPLING LOCATION
- SHALLOW DUG WELL (WW)
- PROPERTY LINE
- PERIMETER OF LANDFILL
- UNPAVED ROAD
- TREES OR BRUSH

0 300
FEET

FIGURE 5-1

LOCATIONS OF MONITORING WELLS, WASTE AND SOIL BORINGS, SURFACE-SOIL AND SURFACE-WATER SAMPLES AMERT SITE INVESTIGATION

PREPARED FOR

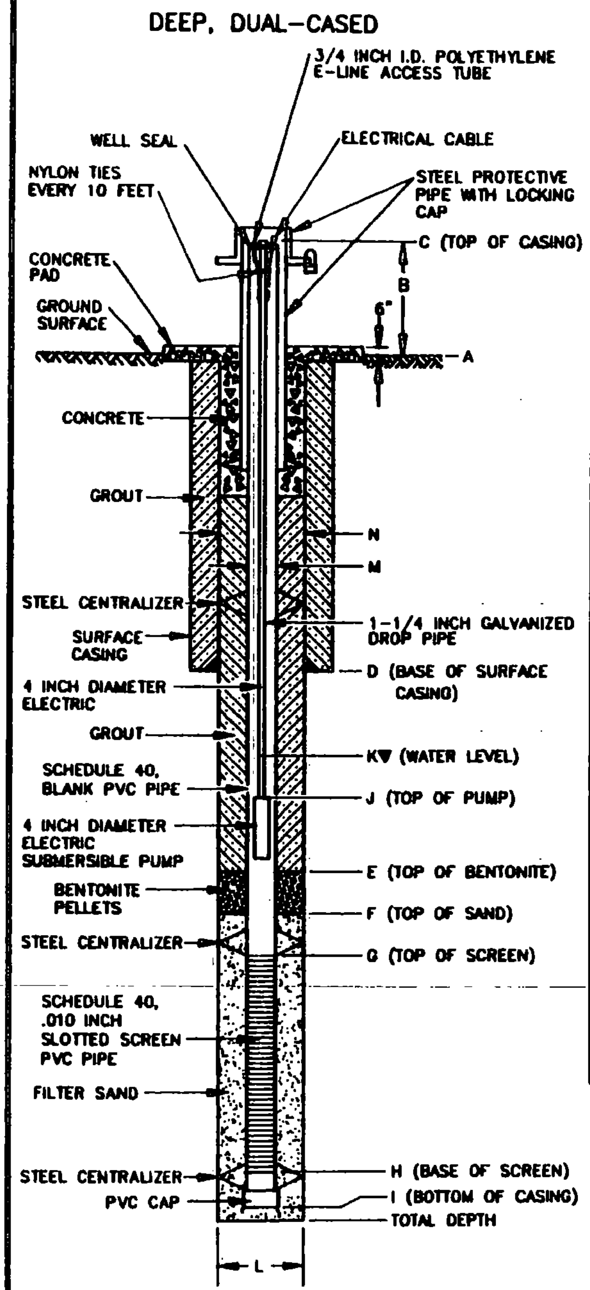
WHIRLPOOL CORPORATION
CLYDE, OHIO

DRAWING NUMBER 446493-A94

DRAFT BY	DRAFT CHK	PROJ. CHK	APPRV. BY
JEA 6/20/90	?? 11/12/90	MB 11-12-90	MB 11-12-90

Do Not Scale This Drawing

Do Not Scale This Drawing	© 1984 IT CORPORATION ALL COPYRIGHTS RESERVED	DRAFT BY	JEA 3/19/90	DRAFT CHK	RRS 11/12/90	PROJ. CHK	ms 11-12-90	APPRV. BY	ms 11-12-90	DRAWING NUMBER	446493-A73



WELL NUMBER	TOTAL DEPTH	ELEVATION (1) (SURFACE)	HEIGHT ABOVE SURFACE	ELEVATION (1) (TOP OF CASING)	DEPTH BELOW GROUND SURFACE							WATER LEVEL (4) (TOP OF CASING)	DIAMETER (INCHES)		
		A	B	C	D	E	F	G	H	I	J	K	L	M(2)	N
SB-1	94.5	685.2	2.8	688.04	35.0	49.0	60.0	69.8	93.6	94.1	65.0	19.5	8	4	12

NOTES:

1. DATUM IS MEAN SEA LEVEL
2. INSIDE DIAMETER
3. DIMENSIONS ARE IN FEET UNLESS OTHERWISE NOTED
4. MEASURED ON NOVEMBER 29, 1989

FIGURE 5-2

GENERAL MONITORING WELL CONSTRUCTION DIAGRAM (DEEP, DUAL-CASED)
AMERT SITE INVESTIGATION

PREPARED FOR

WHIRLPOOL CORPORATION
CLYDE, OHIO

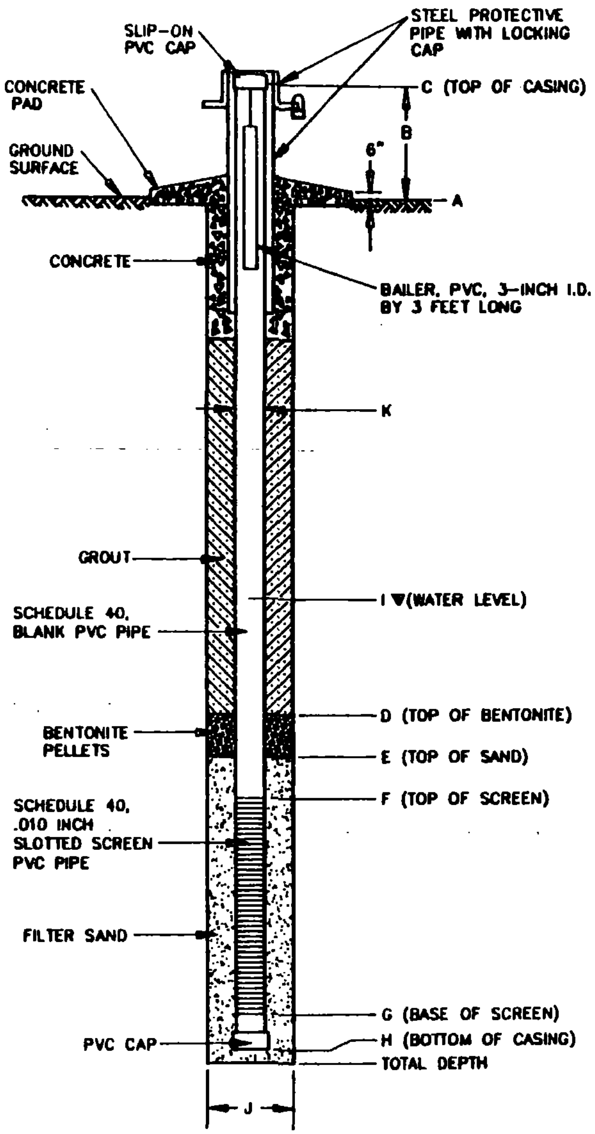
IT

INTERNATIONAL TECHNOLOGY CORPORATION

Do Not Scale This Drawing

DRAFT BY	JEA 3/19/90	DRAFT CHK	RCS 11/12/90	PROJ. CHK	lms 11-12-90	APPRV. BY	lms 11-12-90	DRAWING NUMBER	446493-A72

SHALLOW, SINGLE-CASED



WELL NUMBER	TOTAL DEPTH	ELEVATION (1) (SURFACE)	HEIGHT ABOVE SURFACE	ELEVATION (1) (TOP OF CASING)	DEPTH BELOW GROUND SURFACE					WATER LEVEL(4) (TOP OF CASING)	DIAMETER (INCHES)	
		A	B	C	D	E	F	G	H	I	J	K (2)
MW-1	13.1	687.1	2.4	689.49	4.0	6.0	8.2	12.1	13.0	10.40	10	4
MW-2	22.3	687.1	2.6	689.73	11.0	14.0	16.0	20.0	20.9	10.56	10	4
MW-3	10.5	678.9	2.7	681.62	1.5	3.0	5.5	9.5	10.3	7.39	10	4
MW-4	15.5	678.9	2.7	681.56	4.5	7.5	10.4	14.3	15.2	7.26	10	4
MW-5	20.0	684.2	2.9	687.07	6.5	8.5	10.0	19.1	19.9	11.67	10	4
MW-6	14.5	685.0	2.8	687.75	7.0	9.0	9.3	13.3	14.2	12.18	10	4
MW-7	21.5	685.0	2.7	687.70	11.0	14.3	16.6	20.5	21.4	12.14	10	4
MW-8	19.5	683.5	2.6	686.05	4.0	7.5	9.5	18.5	19.4	10.40	10	4
MW-9	19.9	685.6	2.6	688.16	6.0	8.5	9.9	18.8	19.5	11.13	10	4
MW-10	20.0	687.5	2.8	690.30	5.5	8.0	9.8	18.8	19.4	12.97	10	4
MW-11	7.5	671.7	2.3	674.03	0.0	2.0	2.6	6.6	7.3	3.78	10	4
MW-12	4.0	666.6	2.6	669.20	0.0	1.0	1.8	3.8	4.0	4.04	10	4

NOTES:

1. DATUM IS MEAN SEA LEVEL
2. INSIDE DIAMETER
3. DIMENSIONS ARE IN FEET UNLESS OTHERWISE NOTED
4. MEASURED ON DECEMBER 5, 1989

FIGURE 5-3

GENERAL MONITORING WELL CONSTRUCTION DIAGRAM (SHALLOW, SINGLE CASED) AMERT SITE INVESTIGATION

PREPARED FOR

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Table 5-1. Summary of Wells and Borings

Waste Borings	
Number:	3
Nominal Depth:	10 ft
Sampling:	Continuous split barrel; PID screening; 3 samples collected per hole
Monitoring Wells - Shallow	
Number:	12
Nominal Depth:	20 ft
Sampling:	Continuous split barrel; PID screening; 1 sample collected per hole*
Screen:	4 in Sch 40 PVC, 0.010 in millslot, 5-10 ft long
Casing:	4 in Sch 40 PVC
Stratigraphic Borings/ Deep Well	
Number:	2 (1 completed as monitoring well)
Nominal Depth:	90 ft
Sampling:	Split spoon or Shelby tube every 10 ft, and/or gamma log
Screen:	4 in Sch 40 PVC, 0.010 in millslot, 20 ft long
Casing:	4 in Sch 40 PVC
Surface Casing:	8 in Sch 40 to 30 ft

* Samples not collected from second well of two-well pair

Table 5-2. Summary of Environmental Samples

Type and Source	Number of Samples	Number of Composite Samples	Results of Analyses
Waste "WB" *			
Waste Borings (3 borings)	9	1	Table 6-2
Surface soils (6 - 12 inches deep) "SS"			
Shallow Holes **	34	34	Table 6-3
Subsurface soils (1 - 4 feet deep) "MW"			
At Monitor Wells	9	9	Table 6-3
Surface Waters "SW"	3	3	Table 6-4, 6-5
Ground Waters			
Shallow Monitoring Wells "MW"	24	24	Table 6-4, 6-5
Deep Monitoring Well "SB"	1	1	Table 6-4, 6-5
Local Water Wells	1	1	Table 6-4, 6-5
Shallow Dug Well "WW"	1	1	Table 6-4, 6-5

Locations of all sample points shown on Figure 5-1.
* Sample designator prefixes shown in quotes.
** Sixteen (16) locations were sampled twice, two (2) locations were sampled once each.

TABLE 5-3

LIST OF ANALYTICAL PARAMETERS FOR WASTE ANALYSES
(SOLIDS AND SEMISOLIDS)

ANALYSIS	ANALYTICAL METHOD(1)	DETECTION LIMIT	BOTTLE TYPE* AND MINIMUM VOLUME	PRESERVATIVE	RECOMMENDED HOLDING TIME
GENERAL GROUND-WATER QUALITY PARAMETERS	(Preparation by 7-day deionized water leach)				
Alkalinity	310.1(2)	1.0 mg/L (leachate)	500 mL, G, T	Cool to 4°C	14 days
Chloride	325.2(2)	1.0			
Sulfate	375.4(2)	1.0			
Fluoride	340.2(2)	0.02			
Iron	6010	0.01			
Manganese	6010	0.004			
Nitrate	353.1(2)	0.01			
Sodium	6010	0.17			
Calcium	6010	0.1			
Phosphorus	365.3(2)				
Potassium	6010	0.5			
Magnesium	6010	0.30			
APPENDIX IX METALS	(Preparation by method 3050)				
Antimony	7041	0.3 mg/kg	500 mL, G, T	Cool to 4°C	6 months
Arsenic	7060	0.2			
Barium	6010	3			
Beryllium	6010	0.1			
Cadmium	6010	1			
Chromium	6010	0.9			
Cobalt	6010	2			
Copper	6010	1			

TABLE 5-3

LIST OF ANALYTICAL PARAMETERS FOR WASTE ANALYSES
(Continued)

ANALYSIS	ANALYTICAL METHOD[1]	DETECTION LIMIT	BOTTLE TYPE* AND MINIMUM VOLUME	PRESERVATIVE	RECOMMENDED HOLDING TIME
APPENDIX IX EXTRACTABLE ORGANICS	(Preparation by method 3550, 3580)				
(List in Work Plan in Appendix F)	8270	(See results in Appendix D)	500 mL, G, T	Cool to 4°C	7 Days**
APPENDIX IX PESTICIDES AND PCBs	(Preparation by method 3550, 3580)				
alpha-BHC	8080	0.05 mg/kg	500 mL, G, T	Cool to 4°C	7 days**
beta-BHC		0.05			
delta-BHC		0.05			
gamma-BHC (Lindane)		0.05			
Heptachlor epoxide		0.05			
Endosulfan I		0.05			
Dieldrin		0.10			
4,4'-DDE		0.10			
Endrin		0.10			
Endrin aldehyde		0.10			
Endosulfan II		0.10			
4,4'-DDD		0.10			
Endosulfan sulfate		0.10			
Toxaphene		1.0			
4,4'-DDT		0.10			
Methoxychlor		0.50			
Chlordane		0.50			
PCB-1016		0.50			
PCB-1221		0.50			

TABLE 5-3

LIST OF ANALYTICAL PARAMETERS FOR WASTE ANALYSES
(Continued)

ANALYSIS	ANALYTICAL METHOD(1)	DETECTION LIMIT	BOTTLE TYPE* AND MINIMUM VOLUME	PRESERVATIVE	RECOMMENDED HOLDING TIME
APPENDIX IX METALS (continued)	(Preparation by method 3050)				
Lead	7421	0.1 mg/kg	500 mL, G, T	Cool to 4°C	6 months
Mercury	7471	0.02			
Nickel	6010	3			
Selenium	7740	0.5			
Silver	6010	1			
Thallium	7841	0.1			
Tin	7870	100			
Titanium	6010	3			
Vanadium	6010	2			
Zinc	6010	0.9			
ADDITIONAL PARAMETERS	(Preparation as specified in the individual method listed)				
Boron	6010	0.2 mg/kg	500 mL, G, T	Cool to 4°C	28 days
Cyanide	9010	1			
TOC	9060	1			
Sulfide	9030	0.1			
Total Phosphorus	365.3(2)				
APPENDIX IX VOLATILE COMPOUNDS	(Preparation by method 5030)				
(List in Work Plan in Appendix F)	8240	(See results in Appendix D)	125 mL, G, T	Cool to 4°C	14 days

TABLE 5-3

LIST OF ANALYTICAL PARAMETERS FOR WASTE ANALYSES
(Continued)

ANALYSIS	ANALYTICAL METHOD[(1)]	DETECTION LIMIT	BOTTLE TYPE* AND MINIMUM VOLUME	PRESERVATIVE	RECOMMENDED HOLDING TIME
APPENDIX IX PESTICIDES AND PCBs (Continued)	(Preparation by method 3550, 3580)				
PCB-1232	8080	0.50 mg/kg	500 mL, G, T	Cool to 4°C	7 days**
PCB-1242		0.50			
PCB-1248		0.50			
PCB-1254		0.50			
PCB-1260		0.50			
APPENDIX IX HERBICIDES	(Preparation by method 3550, 3580)				
2,4-D	8150	1 mg/kg	500 mL, G, T	Cool to 4°C	7 days**
2,4,5-TP (Silvex)		1			
2,4,5-T		1			

INTERNATIONAL TECHNOLOGY CORPORATION

TABLE 5-3

LIST OF ANALYTICAL PARAMETERS FOR WASTE ANALYSES
(Continued)

NOTES:

1 - EPA, SW846 Test Methods for Evaluating Solid Waste, Physical Chemical Methods, 3rd Edition, 1986.
2 - USEPA, Chemical Analysis of Water and Wastewater, 1983.

*Bottle Types:
(G) Glass
(T) Teflon-lined cap

**Sample must be extracted in 7 days, maximum holding time is 35 days

The laboratory attempts to reach the published method detection limit, subject to the following:

- Published method detection limits are routinely based upon single analyte analysis under optimum conditions and may not be achievable in actual samples.
- Method detection limits are highly matrix dependent. These limits should be considered as a guidance and may not always be achievable.
- The detectable quantity of a parameter may be affected by high levels of other parameters within the same sample. In these instances, dilution of the sample is the appropriate technique.

* Note that waste samples were tested for all substances listed. Soil samples were tested for a shorter list of parameters.

TABLE 5-4

ANALYTICAL PARAMETERS AND ANALYTICAL METHODS
ENVIRONMENTAL SOIL AND WATER SAMPLES

PARAMETERS FOR SOILS

Constituents	Preparation	Analysis
Arsenic	3050	7060
Barium	3050	6010
Boron	3050*	6010
Cadmium	3050	6010
Chromium	3050	6010
Cobalt	3050	6010
Copper	3050	6010
Cyanide	3050	9010
Iron	3050	6010
Lead	3050	7421
Manganese	3050	6010
Nickel	3050	6010
Sodium	3050	6010
Titanium	3050	6010
Total Phosphorus	3050	365.3
Vanadium	3050	6010
Zinc	3050	6010

PARAMETERS FOR WATERS

Arsenic	Prefiltered	7060
Barium	Prefiltered	6010
Boron	Prefiltered	6010
Cadmium	Prefiltered	6010
Chromium	Prefiltered	6010
Cobalt	Prefiltered	6010
Copper	Prefiltered	6010
Cyanide	Distillation	9010
Iron	Prefiltered	6010
Lead	Prefiltered	7421
Manganese	Prefiltered	6010
Nickel	Prefiltered	6010
Thallium	Prefiltered	7841
Titanium	Prefiltered	6010
Total Phosphorus	N/A	365.3
Vanadium	Prefiltered	6010
Zinc	Prefiltered	6010
Total Petroleum Hydrocarbons	Freon Extraction	418.1
Calcium	Prefiltered	6010
Magnesium	Prefiltered	6010
Potassium	Prefiltered	6010
Sodium	Prefiltered	6010
Alkalinity	N/A	310.1
Sulfate	N/A	375.4
Chloride	N/A	9252
Nitrate	N/A	353.1
Fluoride	N/A	340.2
pH	N/A	150.1
Total Dissolved Solids	N/A	160.1
Specific Conductivity	N/A	120.1

* Boron was analyzed by a hot-water leach method (Am. Soc. of Agronomy, 1982) in samples collected in August 1990.

TABLE 5-5. SURVEY INFORMATION FOR WELLS AND BORINGS

WELL, BORING, OR SAMPLE ID NUMBER (1)	LOCATION		GROUND LEVEL ELEVATION (2) (ft. MSL)	TOP OF PVC CASING ELEVATION (2) (ft. MSL)	DATE COMPLETED
	NORTHING (2)	EASTING (2)			
MW-1	15,836	19,674	687.1	689.49	11/29/89
MW-2	15,829	19,663	687.1	689.73	11/28/89
MW-3	16,707	19,466	678.9	681.62	12/01/89
MW-4	16,706	19,479	678.9	681.56	12/01/89
MW-5	16,487	19,394	684.0	687.07	12/02/89
MW-6	16,507	19,666	685.0	687.75	11/30/89
MW-7	16,508	19,655	685.0	687.70	11/30/89
MW-8	16,505	19,835	683.5	686.05	11/30/89
MW-9	16,125	19,414	685.6	688.16	12/02/89
MW-10	16,138	19,842	687.5	690.30	12/03/89
MW-11	16,840	19,385	671.7	674.03	12/04/89
MW-12	17,060	19,393	666.6	669.20	12/04/89
WB-1	16,343	19,675	686.2	-	11/16/89
WB-2	16,336	19,507	685.7	-	11/16/89
WB-3	16,133	19,605	686.5	-	11/16/89
			-	-	
SB-1 (Deep Well)	16,509	19,630	685.2	688.04	11/18/89
SB-2	15,999	19,614	686.3	-	11/16/89

NOTES: (1) MW - Ground-water monitoring well location.
WB - Waste boring.
SB - Soil boring location.
MSL - Mean sea level
(2) Survey data by Kusmer, Musteric, and Associates, Inc., Fremont, Ohio

6.0

6.0 RESULTS OF FIELD INVESTIGATION

The field investigation of the Amert site was conducted during the period from November 14 to December 6, 1989. Additional sampling events took place in April and August, 1990. The following sections describe the results of the investigation and the hydrogeologic conditions at the site. Chemical analytical results are presented and discussed. Original or transcribed field data is provided in the Appendices:

APPENDIX A - BORING LOGS AND COMPLETION DIAGRAMS
APPENDIX B - SLUG TEST CALCULATIONS
APPENDIX C - SAMPLE COLLECTION LOGS
APPENDIX D - CERTIFICATES OF ANALYSIS AND CHAIN-OF-CUSTODY FORMS
APPENDIX E - LOGS OF LOCAL WATER WELLS

The Work Plan for the field investigation is provided in Appendix F. Appendices D, E, and F are in Volume 2.

6.1 SITE TOPOGRAPHY AND DRAINAGE

In order to more clearly delineate routes of surface run-off and determine the topography of potential discharge areas, a detailed topographic map of the site was made (Figure 6-1a). The map was constructed from aerial photographs taken for this project. Figure 6-1b is an oblique aerial view of the site looking toward the south. Boring locations, sampling points, and other benchmarks and natural landmarks in the area surrounding the site were surveyed on the ground.

The map shows the location of numerous small depressions and rises on the beach ridge on which the landfill has been built. There is a regional topographic slope to the north in the direction of Lake Erie. The map shows the locations of small drainage channels or swales where surface run-off is concentrated. Run-off to the north of the site from rainfall or spring flow is concentrated along pathways shown by arrows in Figure 6-1a. The drainage features continue northward across a pasture or into a field normally planted in row crops (Figure 6-1b). These "channels" are gentle swales and not well defined or incised channels.

All surface drainage in this area flows to Raccoon Creek. The map indicates that there is a potential for surface run-off from the landfill area to flow northward toward parts of adjacent agricultural areas. The three potential contributions to this flow include 1) surface run-off from the landfill area, 2) water which discharges from the peripheral drain system around the landfill, or 3) natural spring discharge. Surface waters from any of these sources would tend to converge on the drainageways indicated on Figure 6-1a. The drainage channels do not appear to cross the area of affected crops indicated on Figure 6-1a. Poor growth of row crops has been observed in an area further north, however, where the linear drainageway that flows northward through a pasture turns east and enters the row crop field (Figure 6-1b).

The approximate limits of the landfill are shown on Figure 6-1a. The subsurface drain system is located along the south and east sides of the landfill, and the discharge point for this system is shown on Figure 6-1a. The landfill area shown on Figure 6-1a is derived from a 1970 aerial photograph.

6.2 SITE HYDROGEOLOGY

In order to define the subsurface geology, aquifer characteristics, and groundwater quality at the Amert site, twelve shallow monitoring wells were installed and two stratigraphic borings to bedrock were drilled. One of the soil borings also was completed as a bedrock monitoring well. Permeability (slug/bailer) tests were completed in five of the shallow wells. The following sections discuss the local geologic and hydrogeologic conditions at the Amert site.

6.2.1 Geology

The locations of the stratigraphic borings and the monitoring wells are shown in Figure 6-1. The stratigraphic borings indicate that the site is underlain by 70 feet of glacial till and glacio-lacustrine deposits (Figure 6-2). These unconsolidated deposits are underlain by limestone or dolomite carbonate rock, which is the top of the "Big Lime" aquifer (Figure 4-2 and 6-2), a relatively thick section of carbonate and evaporite rocks.

The glacial materials consist of two distinct deposits. The lower section is composed primarily of dense, apparently unfractured clayey silt and silty clay with scattered individual rock fragments and gravel clasts. This section appears to be glacial till, although some of this interval may be lake-bottom deposits. On the crest of the "ridge", the upper interval consists of 20 to 25 feet of fine to medium-grained sand with a few gravelly layers (Figure 6-2). The sand has been interpreted as a lacustrine-margin deposit formed along an ancient shoreline of a periglacial lake, the ancestral Lake Warren (Stout and others, 1943). The base of the sand body is relatively flat; the sand thins to the north toward the area downslope from the preserved beach ridge. A few thin sand intervals were found below the main sand body.

In the landfill area, the upper four to six feet consists of sandy and clayey cap material and waste fill. The fill consists of layered tan, red and orange, fine-grained, clay-like material. The fill is underlain by fine to coarse-grained sand. The fill sediments encountered in the waste borings were primarily recognizable by their different colors and thin (1/2 to 4-inch) layering compared to the native sediments.

6.2.2 Ground Water

Shallow ground-water was encountered in all of the borings for monitoring wells at depths ranging from two to eight feet below ground surface. The shallower water depths occur north of the landfill, below the north-facing slope of the subdued ridge. Construction diagrams for the thirteen monitor wells are included in Appendix A. Most of the wells were installed with five to ten feet of screen set in the bottom of the borehole. Six of the wells were installed as three two-well pairs. Each well pair consisted of one well with five feet of screen set near the top of the sand and a second well with a five-foot long screen set near the bottom of the sand. The two wells to the north of the site (MW-11 and MW-12) were shallower and had shorter screens due to the northward thinning of the sand. The deepest well, SB-1, was set at 94 feet total depth and screened from 69.8 to 94.0 feet in order to test the water quality in the limestone aquifer.

Water level measurements are shown on Table 6-1. A potentiometric surface map constructed using the December 5 data indicates that ground-water flow in the shallow sand generally follows the surface topography and flows in a northerly direction (Figure 6-3). Ground-water discharges in the area to the north of the site, as described in Section 6.5.

Samples of the silty and clayey till which makes up most of the unconsolidated glacial deposits did not appear to have fractured or oxidized zones or partings. The clay was hard and had a dry appearance similar to mudstone. Gravel-size clasts were found enclosed within the clay and silt matrix.

Hydraulic conductivity of the shallow water bearing sand was measured in monitoring wells MW-4, MW-5, MW-8, MW-9 and MW-10. The slug tests were performed as described in Section 5.8. Results of the slug tests suggest that the hydraulic conductivity of the sediments in which these wells are completed is approximately 17 ft/day or 130 gpd/ft^2 (Table 6-6). Calculations for the slug tests are included in Appendix B.

The velocity of the ground water can be estimated from Darcy's Law:

$$q = Ki/p$$

where:
q = velocity (L/T)
K = hydraulic conductivity (L/T)
i = hydraulic gradient (L/L or dimensionless)
p = effective porosity (dimensionless decimal fraction)

The hydraulic gradient is equal to the change in water level elevation divided by the horizontal distance between the measuring points. The change in water levels between monitoring well MW-1 and MW-4 on December 5, 1989 was 4.79 feet. The distance between these two wells is approximately 900 feet, yielding a hydraulic gradient of 0.0053. Using the average hydraulic conductivity measured in MW-5, MW-8, MW-9, and MW-10 (17 ft/day), and an assumed porosity typical of fine sands of 0.25, the ground-water flow rate would be approximately 0.36 ft/day or 130 feet per year. A steeper hydraulic gradient is apparent to the north of the site. Using the gradient measured between MW-4 and MW-12 (0.025), and the hydraulic conductivity measured in MW-4 (2.3 ft/day), the flow rate would be approximately 0.23 ft/day or 84 feet per year.

6.3 RESULTS OF CHEMICAL ANALYSIS

As described in Section 5.0, samples of soils, ground waters and surface waters were collected for laboratory analysis during the field investigation. The sampling and analysis program was to identify whether any of the compounds listed in 40 CFR 264, Appendix IX, were present in the landfilled material and then to analyze the soil and water samples for all of the constituents detected in the waste. The following sections describe the results of the analyses of the waste samples, the samples from the soil borings, and the surface-water and ground-water samples.

6.3.1 Results of Waste Sample Analysis

A composite soil sample was prepared from three soil borings collected within the boundaries of the Amert landfill. The nine samples from the three borings were composited into one sample by the method described in Section 5.7. This sample was analyzed for the complete set of Appendix IX parameters listed in Table 5-3. The composite sample was prepared for volatile organics and extractable organics analysis by EPA Methods 5030 and 3550/3580, respectively.

Preparation for metals and other trace elements consisted of complete digestion of the composited waste (EPA 3050). Concentrations of standard major ground-water ions were measured in liquid from a 7-day water leach of this material. Results of the analyses are listed in Table 6-2 and the certificates of analysis are provided in Appendix D.

Generally, the only parameters detected above the method detection limits were metals and trace elements. No volatile or extractable organics, pesticides, herbicides, or PCBs were detected in the waste samples. The analysis of the waste detected primarily barium, boron, iron, titanium, zinc, and organic carbon (TOC). Smaller amounts of arsenic, chromium, cobalt, copper, lead, manganese, nickel, phosphorus, sulfide, and vanadium were found. Very low levels of cadmium, cyanide, and thallium were detected. The chromatograms indicated that measured total organic carbon is due to a mixture of hydrocarbons typically found in lubricating oils. Trace elements not detected in the waste samples include beryllium, antimony, mercury, selenium, silver, and tin. The soil/sediment, surface-water and ground-water samples were analyzed only for those parameters found to be present in the landfill (Table 5-4).

6.3.2 <u>Results of Soil Sample Analysis</u>

Surface and subsurface soil samples were collected from the monitoring well borings (soil samples with prefix "MW") and from other areas in the vicinity of the landfill to determine the concentrations of waste constituents in the unsaturated zone above the water table, and in the near-surface (6 to 12 inches deep) soils (Figure 5-1). Samples SS-10, SS-11, and SS-12 were taken at three different depths (6-12 inches, 12-18 inches, and 18-24 inches, respectively) at one location in a "background" area of the field to the north of the site. Samples SS-13, SS-14, and SS-15, were taken at similar depths at one of the locations in the field where crops have had poor growth. The soil samples collected in December 1989 were analyzed for all the constituents found in the waste samples except cyanide, manganese, and total petroleum hydrocarbons (TPH). The samples collected in April 1990 (SS-6 through SS-17) were analyzed for these constituents plus a subset of the December parameters. Sample locations SS-6 through SS-17 were resampled in August 1990 in order to measure "available" boron by a hot-water leach preparation method (American Society of Agronomy, 1982). Sodium was also measured in these samples for comparison to earlier results for samples from these locations.

The results of the soils analyses are shown in Table 6-3. Figures 6-6 through 6-19 illustrate the concentrations of these parameters and the locations of the samples. A summary of the geochemical observations appears in Table 6-8. Samples considered to have "background" or natural concentrations of the analytes are those from borings for MW-1, MW-8, and MW-10 which are on the upgradient sides (east and south) of the landfill, and from soil samples SS-6 (sandy areas in a field to the east with crops of good appearance); SS-10, SS-11, and SS-12 (clayey area in field to north in area of normal appearance); and SS-16 and (discharge area for unaffected ground water on a slope area to the east).

The maps indicate that the concentration of these elements may be somewhat higher in one or more samples to the north of the site: arsenic, barium, boron, chromium, cobalt, copper, iron, lead, vanadium, sodium, and zinc. However, the higher concentrations of some of these substances appears to be due to agricultural practices or to their naturally higher concentrations in the more clayey soils characteristic of the lake-plain sediments north of the landfill (see Section 6.5.2).

Other elements did not have elevated concentrations in soils or sediments in the area to the north. These include cadmium, nickel, phosphorus, and titanium.

Some of the elements appear to have somewhat lower concentrations in soils and sediments collected on the slope to the north compared to other areas. These include phosphorous, titanium, and cobalt.

The sample collected in the poor-growth area of the cornfield does not appear to have elevated concentrations of the following compounds: arsenic, barium, cadmium, chromium, cobalt, copper, lead, nickel, titanium, vanadium, phosphorus, and zinc. Elements which appear to be slightly elevated in this area are boron, iron, and sodium.

6.3.3 Results of Water Sample Analyses

Surface-water and ground-water samples were collected and analyzed for those parameters detected in the waste samples. Water samples also were analyzed for Standard Water Quality Parameters (major ions and physical parameters). The analytical results are described below by generally comparing them to "background" levels measured in samples from upgradient wells MW-1, MW-2, MW-8, and MW-10. These results are listed in Tables 6-4 and 6-5 and certificates of analysis are included in Appendix D.

In the area downgradient from the landfill, those parameters which appear to be above background levels were alkalinity, boron, fluoride, magnesium, potassium, sodium, sulfate, total dissolved solids, and conductivity. Nickel may be slightly above background levels. Figures 6-20 through 6-32 illustrate the patterns of the concentrations of these parameters in the ground water.

A number of ionic species were detected in the ground water either at very low concentrations or in only a few wells. There is generally not a coherent areal pattern to the very low concentrations of the following ions: arsenic, barium, copper, nickel, nitrate, phosphorus, and vanadium. These substances do not appear to have been released to the groundwater to any significant extent.

The following metals were not detected in ground-water samples: cadmium, chromium, cobalt, lead, and titanium. Calcium, chloride, iron, and zinc were detected but appear to be at or near background levels at all locations.

Due to availability, only one sample of surface water was collected at the site in the December sampling event. This sample was collected from a probable ground-water discharge area where standing water was present (Figure 6-1, point SW-1). This sample had elevated concentrations of alkalinity, boron, fluoride, magnesium, potassium, sodium, and sulfate (slight), and is similar in character to the ground waters in this area (Table 6-5), except that this water generally had lower concentrations of dissolved species compared to those in the ground waters from the wells.

Two additional surface-water samples were collected in the April sampling event. One sample (SW-3) was collected from a natural spring or seep to the west of the landfill. A second (SW-2) was collected from water flowing from the outlet of the subsurface drain system installed around the landfill. SW-3 appeared to contain background concentrations of all species except possibly boron. SW-2 had relatively good water quality, with boron, fluoride, and potassium present at slightly above background concentrations.

Wells MW-1 and MW-2 were installed in order to obtain samples of "background" ground water in the shallow sand in this area. However, water samples from these wells were found to contain boron concentrations in the range of 14 to 29 mg/L. The source of boron in ground water at this location is not known.

6.4 RESULTS OF ANALYSIS OF CAP MATERIAL

Samples of the landfill cap materials that overlie the waste fill were collected during the drilling of the waste sampling borings. It was found that the cover materials were about 2 feet in thickness. They were sampled in three locations, WB-1, WB-2, and WB-3 (Figure 6-1). In general, the cover material consisted of two parts: sandy material at the surface and an underlying layer of fine-grained clayey material. Samples of both the sand and the clay materials were collected at each of the three locations. The samples were analyzed for water content, Atterberg Limits, and grain-size distribution. Certificates of Analysis are included in Appendix D. The results are summarized on Table 6-7.

The results of the analyses indicate that the upper layer consists of fine-grained sand with an average particle diameter of approximately 0.3 mm. The underlying clayey layer, in contrast, has an average grain size of approximately 0.005 mm. As expected, the Atterberg Limits of the three sand samples indicate that they are non-plastic. In contrast, the clayey samples had liquid limits ranging from 27.9 to 35.9 and plastic limits ranging from 18.0 to 22.5. This resulted in a range of plasticity indices of 9.9 to 13.4. All three of the clay samples were characterized as "CL" in the United Soil Classification System, indicating that they are low plasticity clays, a material which was generally low permeability.

The composition and the topography of the cap/cover may be inadequate to prevent recharge by rainfall from entering the landfill, though it is not known if waste materials have been leached because of this. The topography of the landfill slopes slightly northward; however, there are several small depressions in the upper surface of the cap (Figure 6-1a). The small depressions could allow collection and ponding of rainfall, which would provide additional time for percolation through the cover. Results of chemical analysis of ground waters, described in the previous section, provide evidence that water is able to enter the landfill and leach waste constituents, either through the cap or by lateral migration through the aquifer when the water table is high, as described in the next section.

6.5 WASTE CONSTITUENT MIGRATION

The following paragraphs describe an interpretation of the results of this investigation. One of the goals of the investigation was to determine if waste constituents are being released from the landfill and whether these waste constituents are affecting local biota, and whether they may be causing any effects on ground-water resources. Section 6.5.1 below describes the likely recharge and discharge areas. Section 6.5.2 describes the apparent behavior of those elements which appear to have been released from the landfill. Section 6.5.3 describes the apparent effects on vegetation in the vicinity of the landfill. Finally, Section 6.5.4 describes the potential for leachate to affect local ground-water supplies.

6.5.1 Recharge, Discharge, and Ground-Water Movement

Water levels measured in monitoring wells at this site indicate that ground-water flow in the shallow beach-ridge sand is presently to the north-northwest (Figure 6-3). Ground-water movement appears to follow, in general, the northward slope of the topography. Since substances which have been found to be present in the waste fill materials have also been found to be present in elevated concentrations in ground-water samples from the wells downgradient from the site, it appears that these materials can be contacted by ground water and partly dissolved.

The rate of northward migration of ground water has been calculated using the hydraulic conductivities measured in the slug tests (Table 6-6) and the hydraulic gradient calculated using the water level data (Figure 6-3). The calculated northward ground-water velocity is on the order of 100 feet per year. Since the landfill was in operation in the years 1970 to 1976, it is clear that ground-water movement is rapid enough to transport waste constituents to the area near MW-11 and MW-12 in the time since the landfill was in operation. The distance from the northern edge of the landfill to MW-12 is approximately 600 feet.

Recharge to the shallow beach-ridge sand aquifer occurs by infiltration of rainfall on the beach-ridge surface. Rainfall in this area may be able to percolate through the landfill. Below the water table, ground water migrates northward in the direction of the slope of the water table, which generally mimics the topographic slope. Leachate does not appear to be present on the east side of the landfill at wells MW-8 and MW-10 though boron may be somewhat elevated there. It is apparent that the ground-water circulation pathway for much of this water is relatively short. Since the beach-ridge sand pinches out a few hundred feet to the north (Figures 6-2, 6-4, 6-5) and since the underlying glacio-lacustrine lake-bottom deposits and glacial till deposits appear to have low permeability, ground water that moves to the north must eventually re-emerge as discharge since the aquifer essentially terminates near the north property line.

The ground water discharges by several mechanisms. Some of the discharge probably occurs through the leaves of deep-rooted plants. Parts of the discharge area are marked by dense growths of hydrophilic plants. Trees and plants in this area take up ground water through their root systems and evapotranspire it to the atmosphere. Evaporation directly from the soil probably also takes place.

Additionally, some ground water discharges directly onto the land surface, especially when evaporation rates are low or after prolonged rainfall recharge. During the field work in late November and early December 1989, a small flow of water was observed in the area of surface-water sampling location SW-1. The chemical quality of SW-1, which is similar to that of ground waters recovered from wells MW-11 and MW-12 except that concentrations are much lower in SW-1, indicates that it is very likely that this water is discharged groundwater which has been somewhat affected by landfill leachate. The ground-water discharge area for the beach-ridge sands would be expected to encompass much of the land below the beach-ridge crest down to the northernmost limit of the shallow beach-ridge sands (Figure 6-1a, 6-2, 6-4, and 6-5).

A third mechanism for ground-water discharge is through the subsurface interceptor/drain system installed along the south and east sides of the landfill. This system was producing no visible discharge in December, but by April, the winter precipitation had caused a rise in the water table of 2 to 3 feet (Table 6-1, Figure 6-2) and the drain system was discharging water at the point shown on Figure 6-1 at a rate estimated to be approximately 10 to 20 gallons per minute. The quality of the water (sample SW-2, Tables 6-4 and 6-5) is relatively good, however, suggesting that most of this water has not been in contact with waste. Water levels in wells MW-5 through MW-10 appeared to be below the base of the waste materials in both December and April. Therefore, it appears that water entering the drain system in Spring 1990 was made up of a large proportion of ground water relatively unaffected by landfill leachate, and would consist largely of the newly recharged water.

Given the rate of ground-water flow and the thickness of the sand deposit, it is possible to calculate an average rate of ground-water discharge assuming that the flow rate is approximately 100 feet per year to the north, the average saturated thickness is 10 feet and the width of the discharge zone is approximately the width of the landfill (400 feet). The calculated discharge rate for ground water that has passed beneath the landfill is approximately 2,000 gallons per day.

6.5.2 Apparent Releases from the Landfill

As mentioned above, it is apparent that waste materials have been released from the landfill to the ground water and have migrated downgradient to the north. Migration is apparent based on the areal patterns of concentrations in both shallow soil/sediments, in ground waters from the monitoring wells, and in surface water samples. The geochemical observations are summarized in Table 6-8.

However, it is probable that not all of the substances which appear to be present in soils in higher concentrations in the discharge area and in agricultural fields to the north of the site have migrated into those areas from the landfill. There are several other sources for many of these substances:

1. Agricultural activities can involve application of various inorganic substances to the land for fertilizer, and insect and weed control.

2. Naturally-occurring metals are typically found in greater abundance in clayey sediments (found in the fields to the north) compared to sandy sediments (found on the beach ridge).

3. Naturally-occurring metals leached in small concentrations from aquifer sediments by migrating ground-water will tend to concentrate in discharge areas over time as plants evaporate the water and leave dissolved substances behind in the soil.

The ionic species which have the highest concentrations in the water samples downgradient from the landfill, and may have their source in the landfill, include boron, fluoride, magnesium, potassium, sodium, and sulfate. Two other substances, nickel and phosphorus, may also be migrating from the landfill, but the evidence is less conclusive.

The pattern of nickel concentrations in ground waters (Figure 6-27) shows that nickel is present at detectable levels in the area immediately downgradient from the landfill, but that nickel is undetectable in the area of MW-12. Also, it was not detected in the sample of surface water/spring discharge at SW-1 or in the peripheral drain discharge (SW-2). This pattern contrasts with that of the concentrations of nickel measured in shallow soils and sediments (Figure 6-15). Concentrations of nickel in soils in the discharge area are similar to or even less than the concentrations in soils in the agricultural fields to the north, suggesting that any although leached nickel may be accumulating in soil in the discharge zone, concentrations are less than the natural concentrations in the more clayey soils to the north. It should be noted that there is no drinking water standard for nickel.

Phosphorus was detectable in two wells downgradient from the landfill (MW-6 and MW-12) at concentrations just above the detection limits. Phosphorus was also detected in water from the bedrock monitoring well (SB-1) at about the same level. Since the bedrock ground-water does not appear to be affected by other substances from the landfill, it is assumed that this level of phosphorus is naturally occurring in this water. Concentrations of phosphorus in soils are highest in the agricultural areas (Figure 6-16) suggesting that the phosphorus in that area is partially from the use of fertilizers.

Levels of the following metals appear to be higher in the clay-like soils to the north of the landfill, compared to levels in the sandy soils in the landfill area: arsenic, barium, chromium, copper, nickel, and vanadium. Arsenic and copper are probably of agricultural origin as they are ingredients in common farm chemicals.

The common, naturally occurring inorganic ions sodium, magnesium, potassium, and sulfate make up the major part of the materials that have been released from the landfill. Sulfate is present in concentrations in ground water in the northern area at levels above the secondary drinking water standard, which is 200 mg/L. However, the secondary drinking water standards for substances are considered to be primarily aesthetic standards which principally affect the taste and the potential for other uses of the water and are not considered to present a significant risk to human health. Note that the bedrock aquifer also contains relatively high concentrations of sulfate in some area (Shrader Well, Table 6-5).

Cyanide was detected at low levels in ground-water samples from only two wells, MW-9 and MW-10. Cyanide was not detected in wells immediately downgradient from the north end of the landfill.

Petroleum hydrocarbons were not detected in ground-water samples from any of the monitoring wells. It is apparent that the oily materials present within the waste fill are not contributing significant levels of these non-hazardous materials to the ground water.

Of the waste constituents which appear to have migrated from the landfill, the only element which appears to have the potential of causing any environmental concern is boron. Boron in elevated concentrations is known to be detrimental to growth of some plant species. Elevated concentrations of boron are found both in ground waters and in soil/sediment samples to the north of the landfill.

The elevated concentrations of alkalinity are most likely due to boron also, since the analytical method for alkalinity, which involves a titration of samples with an acid, will tend to measure the concentration of bicarbonate, phosphate, and borate ions.

Concentrations of boron ranged up to 250 mg/L in the area to the north (MW-11). Substantial concentrations were also found in soils in this area, and in a sample of ground-water discharge (SW-1) collected in this area.

6.5.3 Effects on Vegetation

This investigation followed complaints from an owner of adjacent property that crop growth was poor in some parts of their fields that were nearest the landfill. In particular, an area of poor corn growth occurs in the area marked on Figure 6-1a and 6-1b. Four soil samples (SS-4, SS-13, SS-14, and SS-15) were taken from the affected area in the southern part of the cornfield. It is likely that this area is being affected by boron, which is transported into the area by ground water.

The affected part of the cornfield is not located in one of the drainageways, and instead is topographically elevated slightly above drainageways to the east and west. Therefore, it appears likely that boron is not moving to this area in surface water flow or in water discharged from the drain system, which discharges at the point indicated on Figure 6-1a.

Figure 6-4 shows a cross-section of the area illustrating the probable subsurface controls on ground-water discharge. It is likely that the affected area is a discharge area for ground water because beach-ridge sand extends northward and under this part of the field. The presence of underlying sand was suggested by the fact that the soils in this part of the field are of a lighter color than the soils in the rest of the field to the east and north. This was confirmed during collection of soil samples SS-13, SS-14, and SS-15 in April when sand was encountered at a depth of 8 inches. It appears, therefore, that this corner of the field is underlain by a tongue or lobe of the beach-ridge sand (Figure 6-5). If this is true, ground water may move as far north as the affected area in this field, where the water would discharge by evaporation from soil or through the leaves of the crops planted in this area. For this reason, it seems unlikely that the area that is being affected by boron will become larger, since its size is controlled by the size of the underlying lobe of beach-ridge sand.

Surface waters have apparently carried boron along the swale that forms the north-trending drainageway through the pasture immediately west of the cornfield (Figure 6-1b). This drainageway turns eastward and re-enters the cornfield several hundred feet to the north. Crops in an area near the western edge of the field also appear to be slightly affected.

6.5.4 Effects on Ground-Water Supplies

A survey of local water well usage indicates that all domestic wells in the area surrounding the landfill site are completed in the bedrock aquifer. Stratigraphic borings SB-1 and SB-2 indicate that the beach-ridge sand is separated from the bedrock aquifer by approximately 50 feet of fine-grained glacial till and lacustrine deposits. Comparison of the water levels measured in MW-7 and MW-6 with that measured in SB-1 indicate that water levels in the bedrock aquifer are approximately 10 feet lower than the water levels in the beach-ridge sand. In locations away from the beach ridge, the water level in the bedrock aquifer would be projected to be above ground surface, and in fact several of the logs of wells completed in bedrock indicate that they originally flowed at the surface. The off-site well sampled during this study (Shrader) was flowing when it was sampled.

A sample of ground water was collected from the bedrock aquifer from well SB-1, which is completed at the north edge of the landfill, and from the above-mentioned off-site private well. None of the constituents which were found to be in the landfill waste materials have elevated concentrations in the samples of ground water collected from these wells.

A single exception is sulfate, which is known to occur naturally in the bedrock aquifer due to the presence of anhydrite and gypsum beds in rocks of the Salina Group (ODNR, 1970).

The glacial till which separates the beach-ridge sand from the bedrock aquifer appears to have very low permeability, and it appears that these sediments would offer an excellent barrier to downward flow of ground water. Logs of nearby water wells suggest that any local concentrations of sandy deposits that might furnish a pathway through the clayey and silty glacial sediments do not exist in this area.

DRAWING NUMBER 446493-A74

DRAFT BY	JEA 3/20/90
DRAFT CHK	
PROJ. CHK	
APPRV. BY	

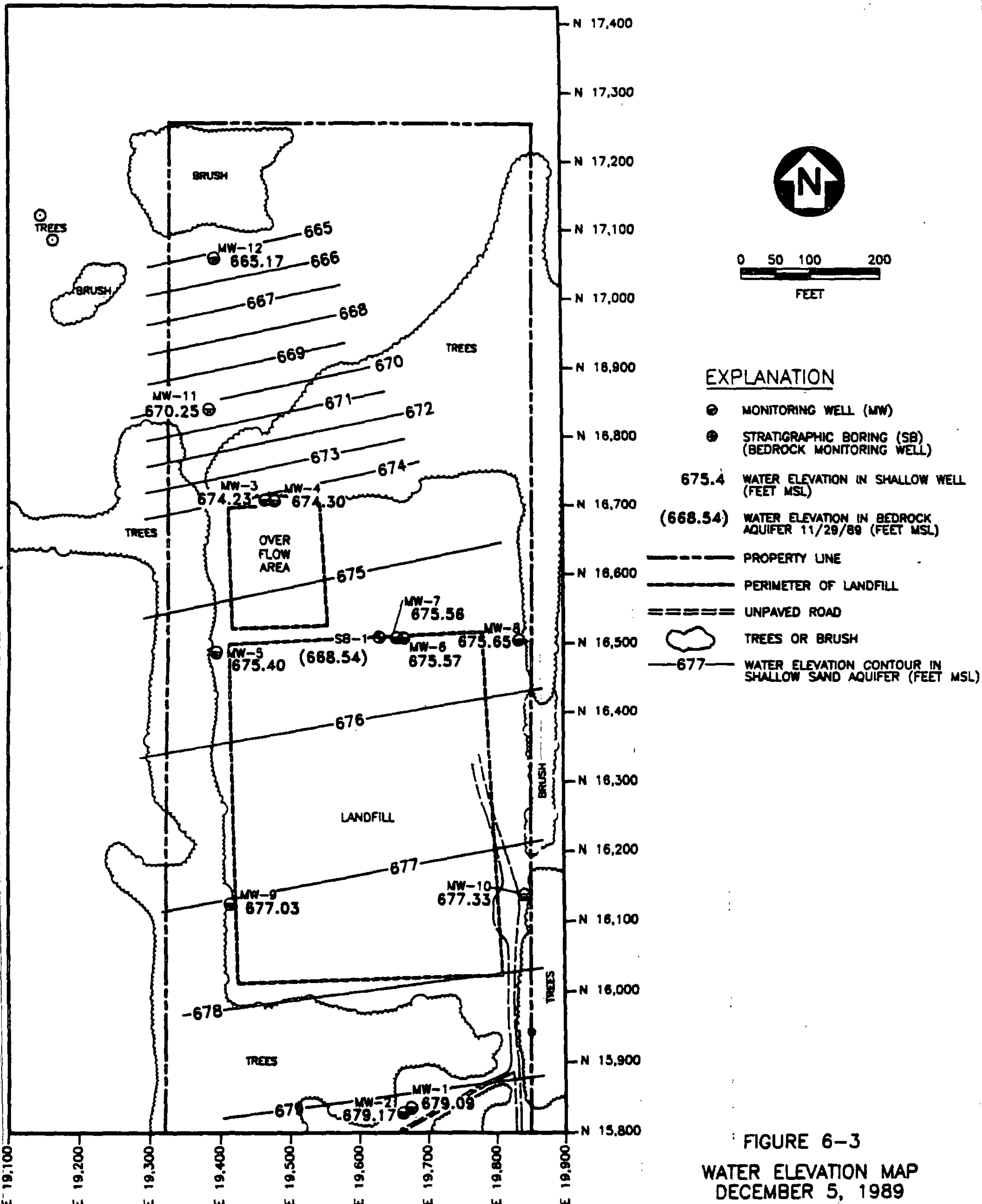

FIGURE 6-3
WATER ELEVATION MAP
DECEMBER 5, 1989
AMERT SITE INVESTIGATION
PREPARED FOR
WHIRLPOOL CORPORATION
CLYDE, OHIO

MAP SOURCE: AEROCON, INC.; GROUND SURVEY: KUSMER, MUSTERIC, AND ASSOCIATES

Do Not Scale This Drawing

Do Not Scale This Drawing

DRAFT BY	JEA 3/28/90	DRAFT CHK	RGS 11/12/90	PROJ. CHK	MB 11-12-90	APPRV. BY	MB 11-12-90	DRAWING NUMBER	446493-A76

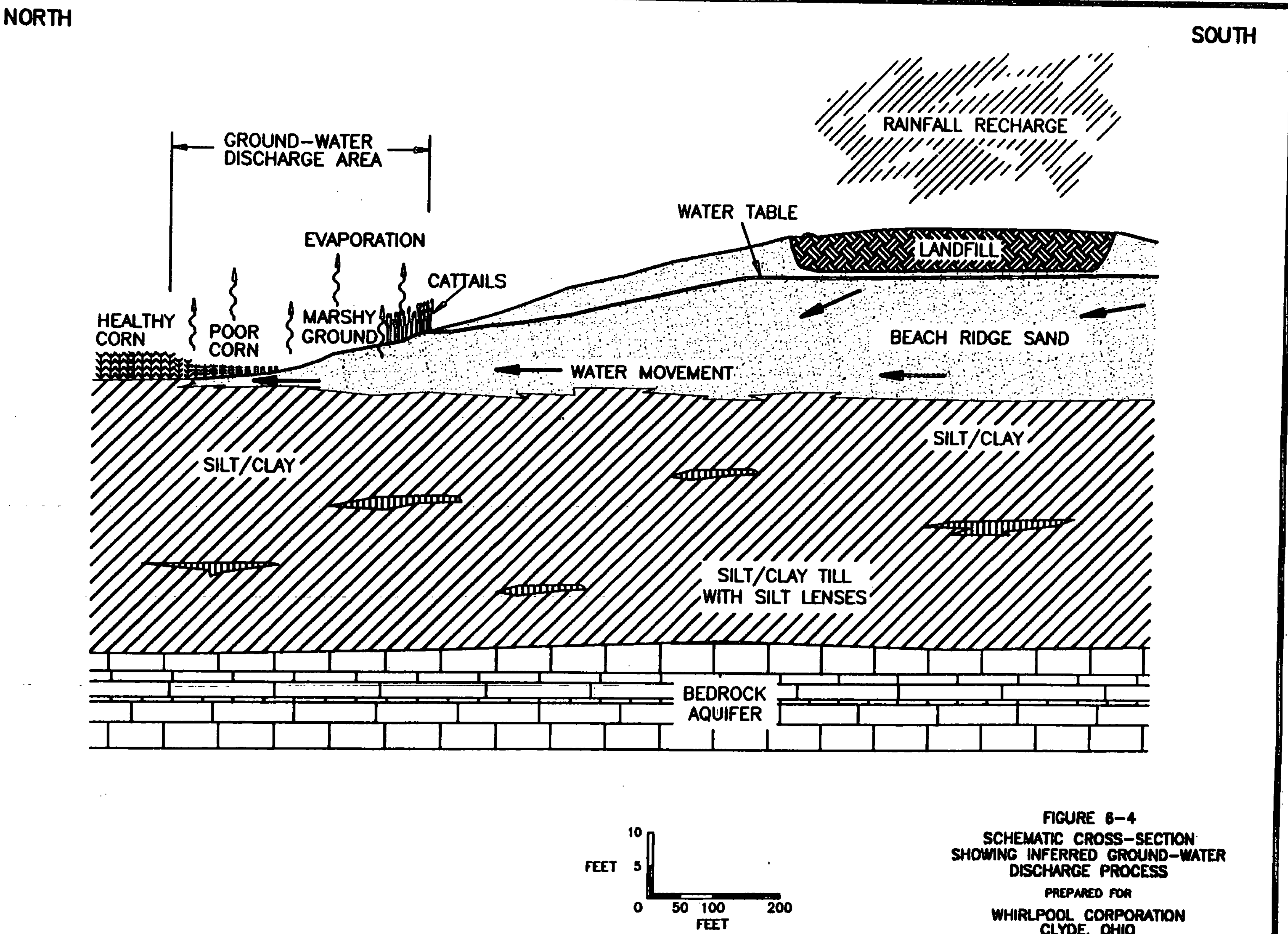

FIGURE 6-4
SCHEMATIC CROSS-SECTION SHOWING INFERRED GROUND-WATER DISCHARGE PROCESS
PREPARED FOR
WHIRLPOOL CORPORATION
CLYDE, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

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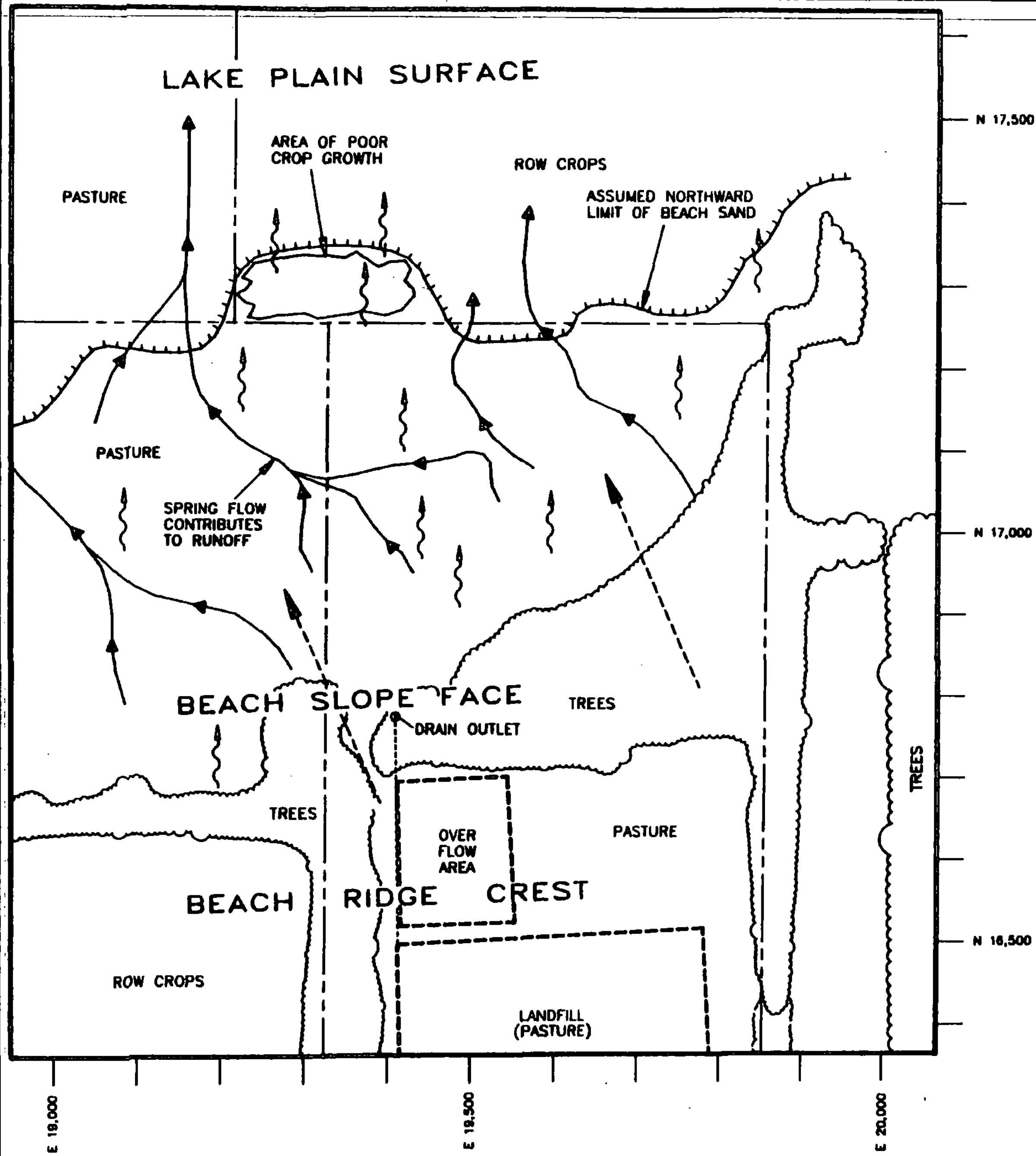

EXPLANATION

ASSUMED DOWNDIP LIMIT OF BEACH SAND

PROPERTY LINE

PERIMETER OF LANDFILL

TREES OR BRUSH

SURFACE-WATER DRAINAGE PATH

GROUND-WATER DISCHARGE AREA

DIRECTION OF GROUND-WATER MOVEMENT

FIGURE 6-5

SCHEMATIC PLAN VIEW
SHOWING ROUTES OF GROUND-WATER
AND SURFACE-WATER DISCHARGE
AMERT SITE INVESTIGATION

PREPARED FOR

WHIRLPOOL CORPORATION
CLYDE, OHIO

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INTERNATIONAL TECHNOLOGY CORPORATION

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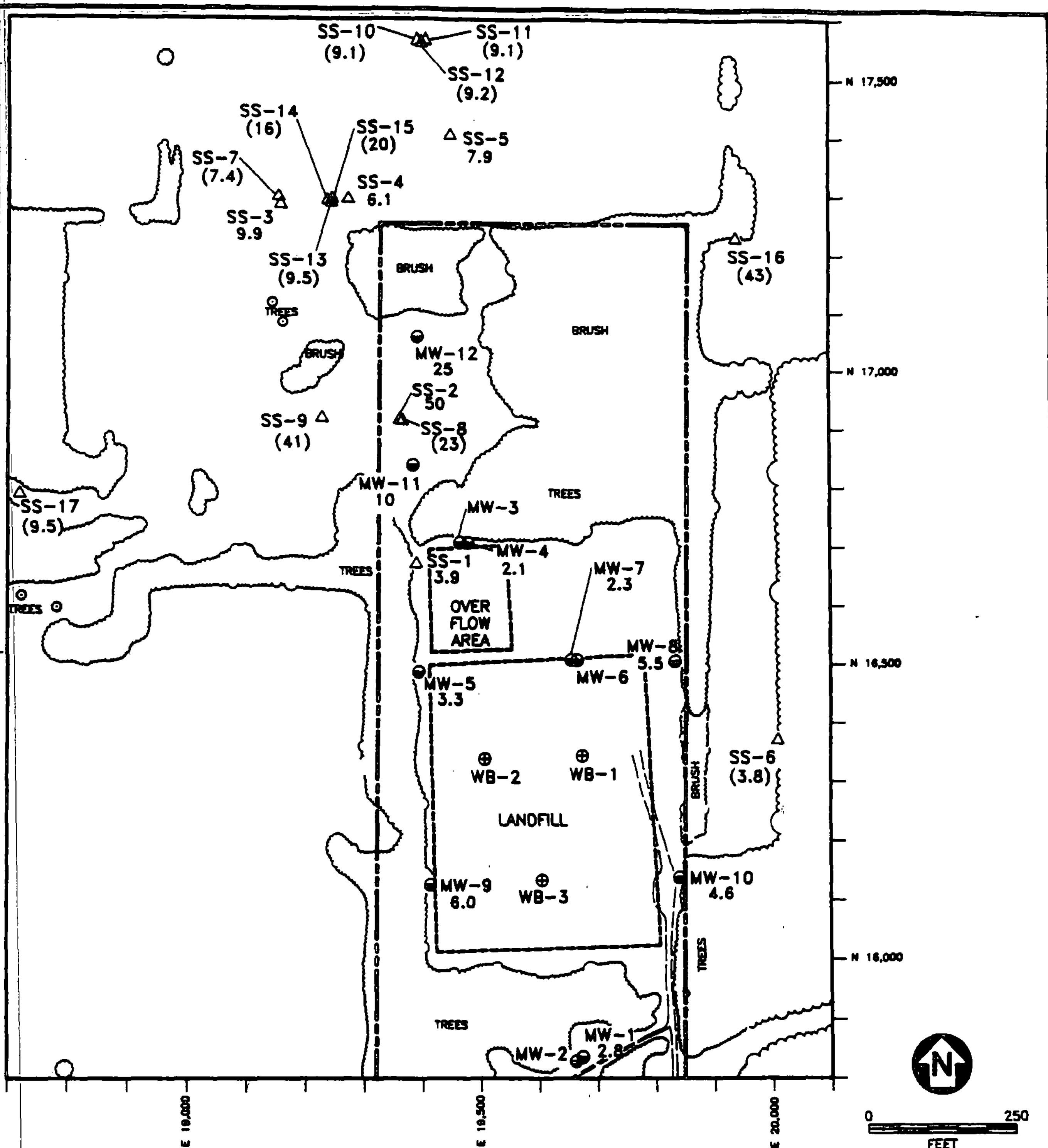


EXPLANATION

- MONITORING WELL (MW)*
- WASTE BORING (WB)
- SURFACE SOIL (SS) SAMPLING LOCATION
- 25 ARSENIC CONCENTRATION (mg/Kg) DECEMBER 1989
- (41) ARSENIC CONCENTRATION (mg/Kg) APRIL 1990
- PROPERTY LINE
- PERIMETER OF LANDFILL
- UNPAVED ROAD
- TREES OR BRUSH

* SOIL SAMPLE COLLECTED FROM BORING FOR WELL.

FIGURE 6-6

CONCENTRATION OF
ARSENIC
IN SOIL AND SEDIMENT
AMERT SITE INVESTIGATION

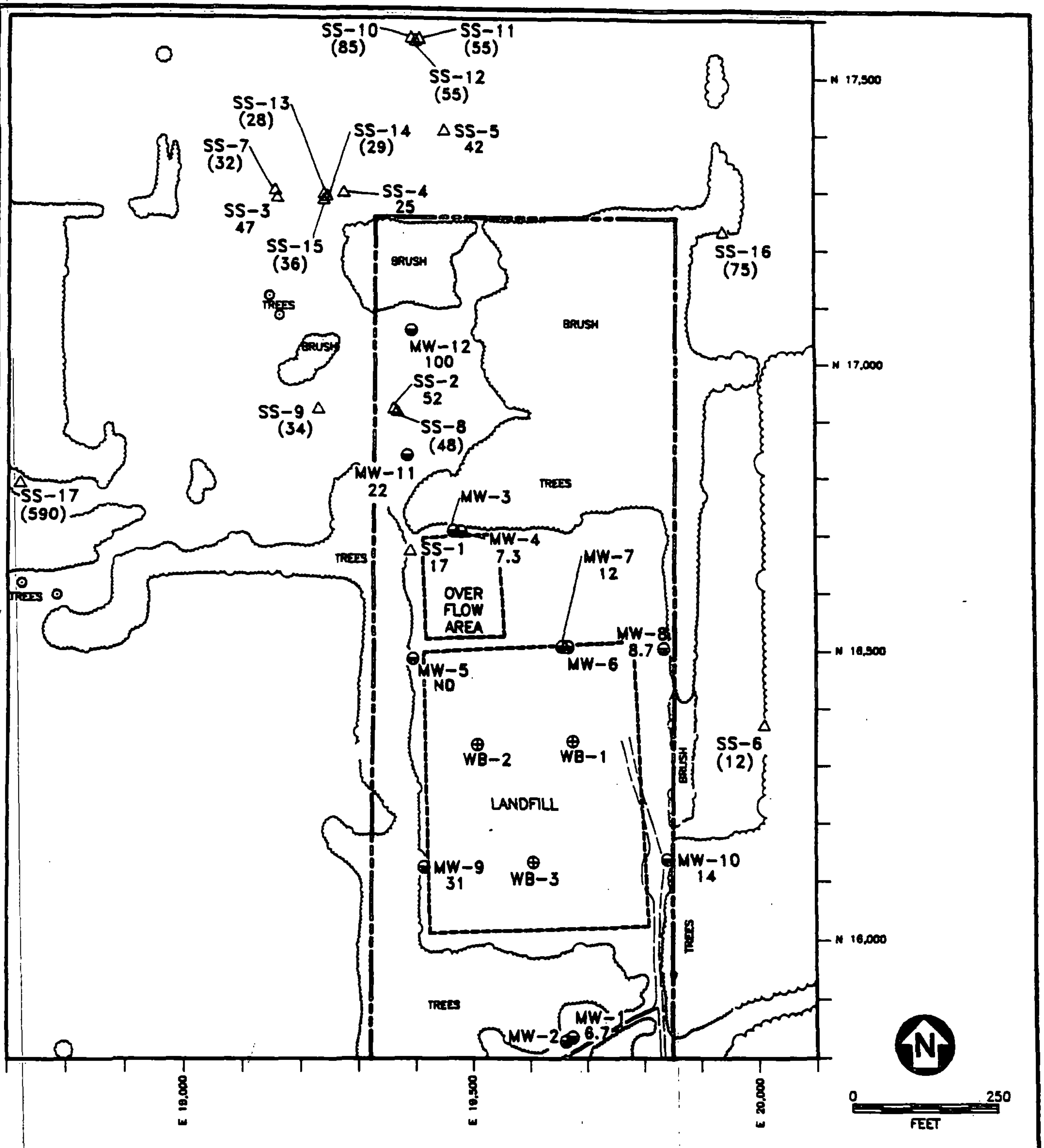
PREPARED FOR

WHIRLPOOL CORPORATION
CLYDE, OHIO

DRAWING NUMBER 446493-A58

DRAFT BY	JEA 3/16/90
DRAFT CHK	RPS 11/12/90
PROJ. CHK	MB 11-12-90
APPRV. BY	MB 11-12-90

Do Not Scale This Drawing



EXPLANATION

- MONITORING WELL (MW) *
- WASTE BORING (WB)
- SURFACE SOIL (SS) SAMPLING LOCATION
- 25 BARIUM CONCENTRATION (mg/Kg) DECEMBER 1989
- (34) BARIUM CONCENTRATION (mg/Kg) APRIL 1990
- ND BARIUM CONCENTRATION BELOW DETECTION LIMIT
- PROPERTY LINE
- PERIMETER OF LANDFILL
- UNPAVED ROAD
- TREES OR BRUSH

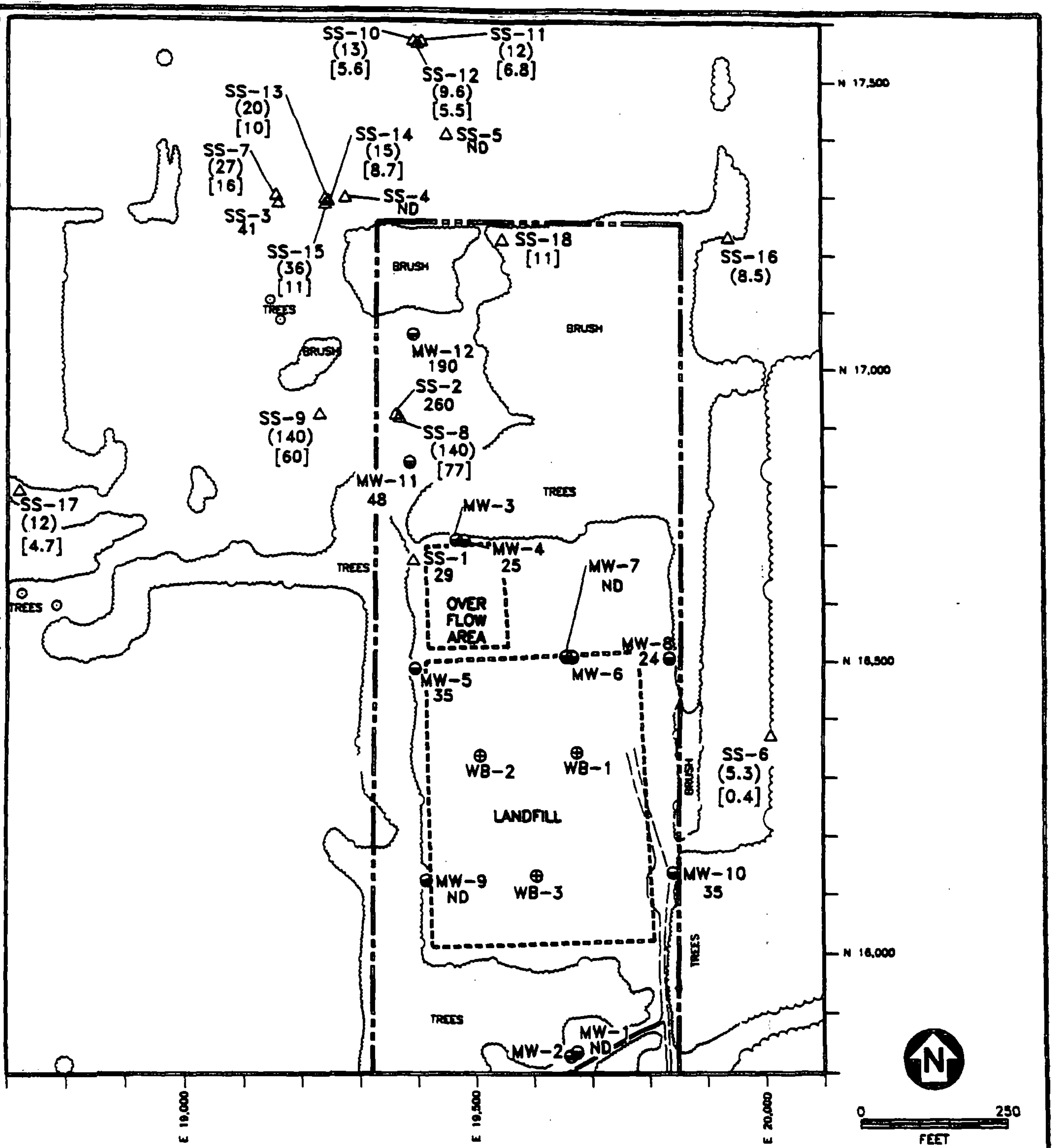
* SOIL SAMPLE COLLECTED FROM BORING FOR WELL.

FIGURE 6-7
CONCENTRATION OF
BARIUM
IN SOIL AND SEDIMENT
AMERT SITE INVESTIGATION
PREPARED FOR
WHIRLPOOL CORPORATION
CLYDE, OHIO

DRAFT BY	JEA 3/16/90
DRAFT CHK	[illegible] 11/12/90
PROJ. CHK	MB 11-12-90
APPRV. BY	MB 11-12-90
DRAWING NUMBER	446493-A59

DRAWING NUMBER 446493-A60

DRAFT BY	JEA 3/16/90	DRAFT CHK	RGS 11/12/90	PROJ. CHK	MB 11-12-90	APPRV. BY	MB 11-12-90



EXPLANATION

- ⊖ MONITORING WELL (MW) •
- ⊕ WASTE BORING (WB)
- △ SURFACE SOIL (SS) SAMPLING LOCATION
- 41 BORON CONCENTRATION (mg/Kg) DECEMBER 1989 (TOTAL DIGESTION)
- (27) BORON CONCENTRATION (mg/Kg) APRIL 1990 (TOTAL DIGESTION)
- [16] BORON CONCENTRATION (mg/Kg) AUGUST 1990 (HOT-WATER LEACH)
- ND BORON CONCENTRATION BELOW DETECTION LIMIT
- PROPERTY LINE
- PERIMETER OF LANDFILL
- UNPAVED ROAD
- TREES OR BRUSH
- * SOIL SAMPLE COLLECTED FROM BORING FOR WELL.

FIGURE 6-8

CONCENTRATION OF BORON IN SOIL AND SEDIMENT AMERT SITE INVESTIGATION

PREPARED FOR

WHIRLPOOL CORPORATION CLYDE, OHIO

Do Not Scale This Drawing

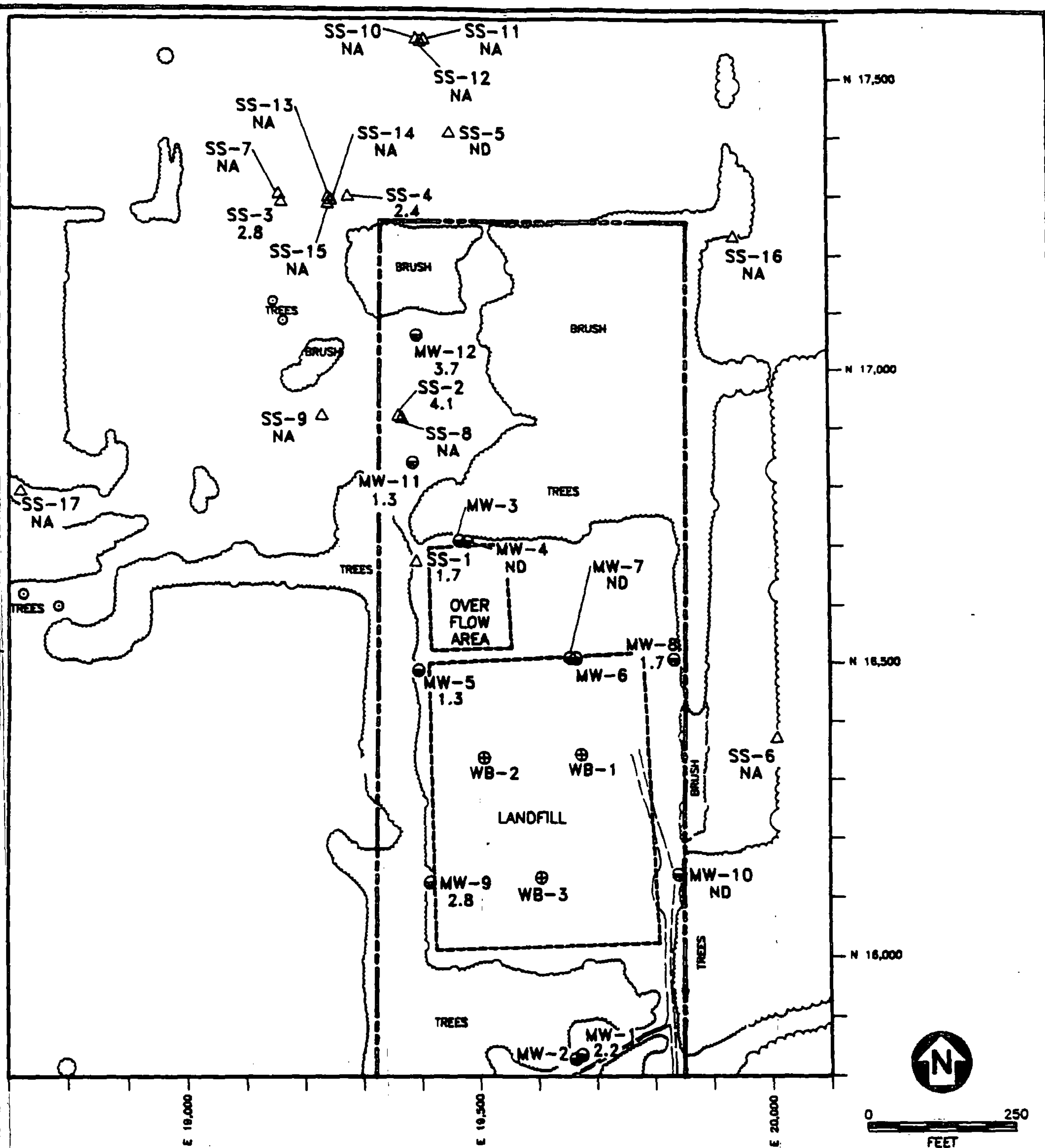
DRAWING NUMBER 446493-A65

APPRV. BY 11-12-90

PROJ. CHK 11-12-90

DRAFT CHK

DRAFT BY JEA 3/16/90



EXPLANATION

- MONITORING WELL (MW)
- WASTE BORING (WB)
- SURFACE SOIL (SS) SAMPLING LOCATION
- 1.7 CADMIUM CONCENTRATION (mg/Kg) DECEMBER 1989
- ND CADMIUM CONCENTRATION BELOW DETECTION LIMIT
- NA NOT ANALYZED
- PROPERTY LINE
- PERIMETER OF LANDFILL
- UNPAVED ROAD
- TREES OR BRUSH
- * SOIL SAMPLE COLLECTED FROM BORING FOR WELL.

FIGURE 6-9

CONCENTRATION OF
CADMIUM
IN SOIL AND SEDIMENT
AMERT SITE INVESTIGATION

PREPARED FOR

WHIRLPOOL CORPORATION
CLYDE, OHIO

Do Not Scale This Drawing

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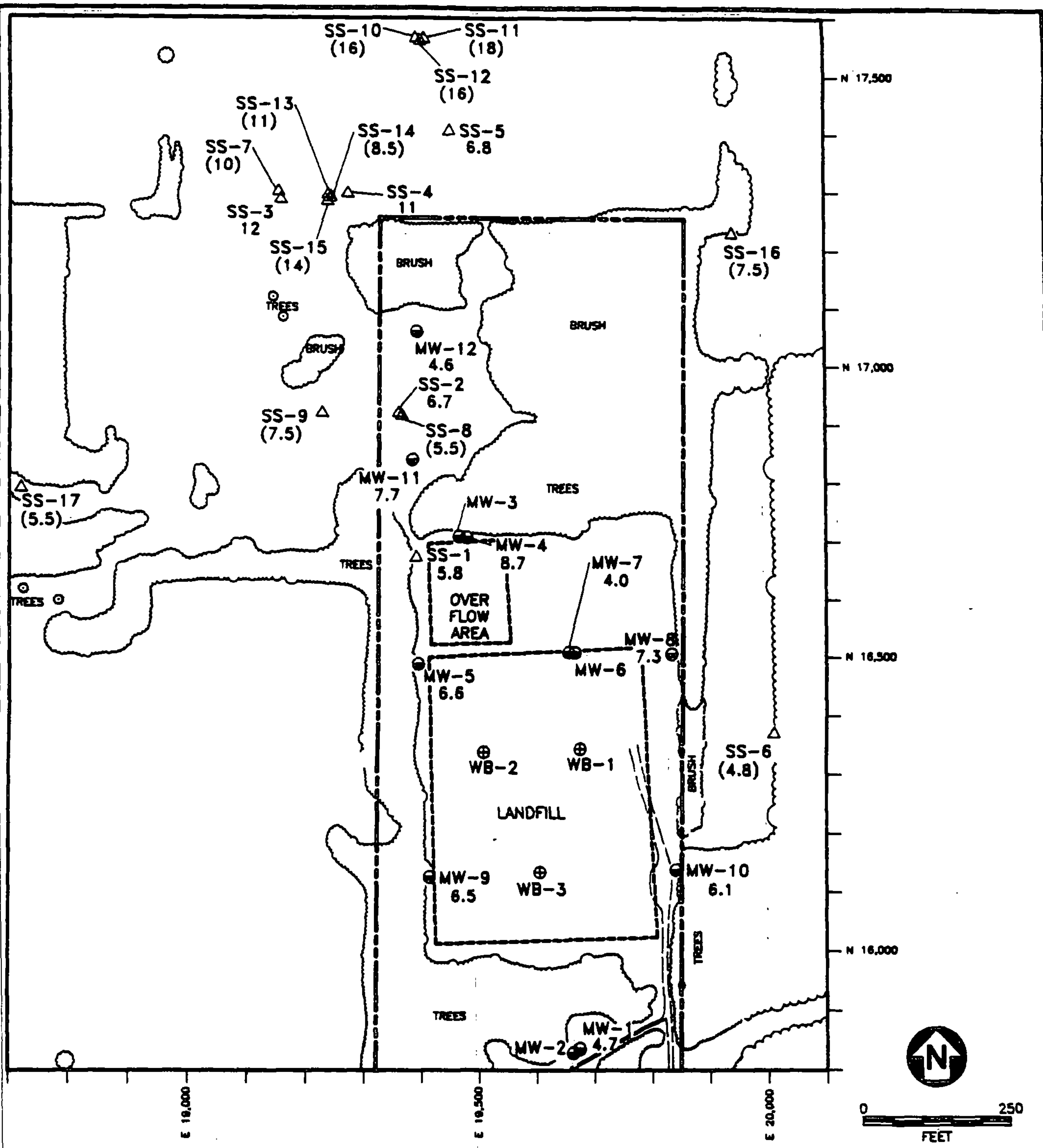
DRAFT BY: JEA 3/16/90

DRAFT CHK: 11-12-90

PROJ. CHK: 11-12-90

APPRV. BY: 11-12-90



EXPLANATION

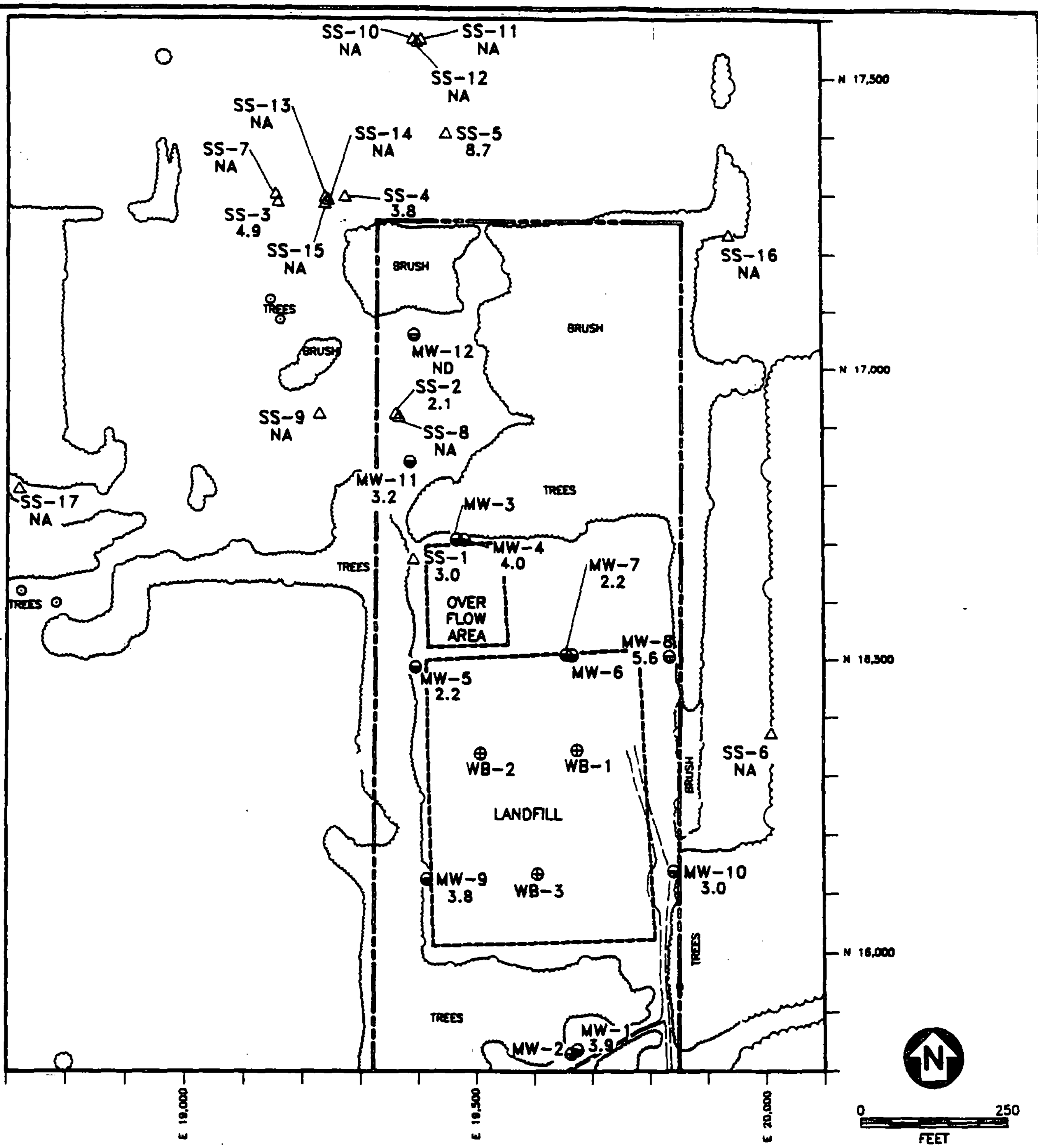
- ⊖ MONITORING WELL (MW) *
- ⊕ WASTE BORING (WB)
- △ SURFACE SOIL (SS) SAMPLING LOCATION
- 12 CHROMIUM CONCENTRATION (mg/Kg) DECEMBER 1989
- (10) CHROMIUM CONCENTRATION (mg/Kg) APRIL 1990
- PROPERTY LINE
- PERIMETER OF LANDFILL
- UNPAVED ROAD
- TREES OR BRUSH

* SOIL SAMPLE COLLECTED FROM BORING FOR WELL

FIGURE 6-10
CONCENTRATION OF
CHROMIUM
IN SOIL AND SEDIMENT
AMERT SITE INVESTIGATION
PREPARED FOR
WHIRLPOOL CORPORATION
CLYDE, OHIO

DRAWING NUMBER 446493-A70

DRAFT BY	JEA 3/16/90	DRAFT CHK		PROJ. CHK	VMS 11-12-90	APPRV. BY	VMS 11-12-90



EXPLANATION

- MONITORING WELL (MW) *
- WASTE BORING (WB)
- SURFACE SOIL (SS) SAMPLING LOCATION
- 2.1 COBALT CONCENTRATION (mg/Kg) DECEMBER 1989
- ND COBALT CONCENTRATION BELOW DETECTION LIMIT
- NA NOT ANALYZED
- PROPERTY LINE
- PERIMETER OF LANDFILL
- UNPAVED ROAD
- TREES OR BRUSH

* SOIL SAMPLE COLLECTED FROM BORING FOR WELL.

FIGURE 6-11

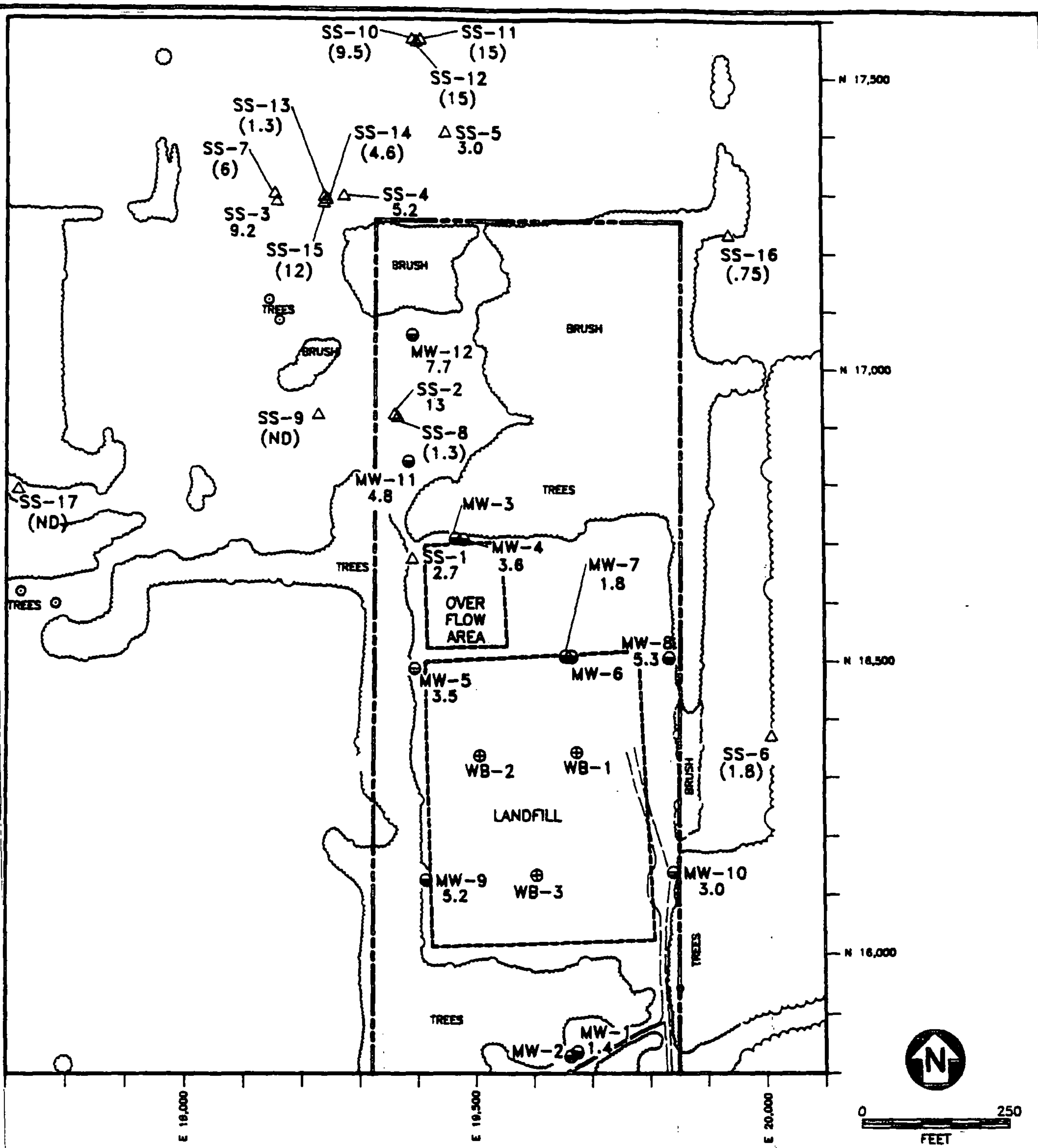
CONCENTRATION OF COBALT IN SOIL AND SEDIMENT AMERT SITE INVESTIGATION

PREPARED FOR

WHIRLPOOL CORPORATION CLYDE, OHIO

DRAWING NUMBER 446493-A61

DRAFT BY	DRAFT CHK	PROJ. CHK	APPRV. BY
JEA 3/16/90	11/12/90	11-12-90	11-12-90



EXPLANATION

- MONITORING WELL (MW) *
- WASTE BORING (WB)
- SURFACE SOIL (SS) SAMPLING LOCATION
- 13 COPPER CONCENTRATION (mg/Kg) DECEMBER 1989
- (1.8) COPPER CONCENTRATION (mg/Kg) APRIL 1990
- ND COPPER CONCENTRATION BELOW DETECTION LIMIT
- PROPERTY LINE
- PERIMETER OF LANDFILL
- UNPAVED ROAD
- TREES OR BRUSH

* SOIL SAMPLE COLLECTED FROM BORING FOR WELL

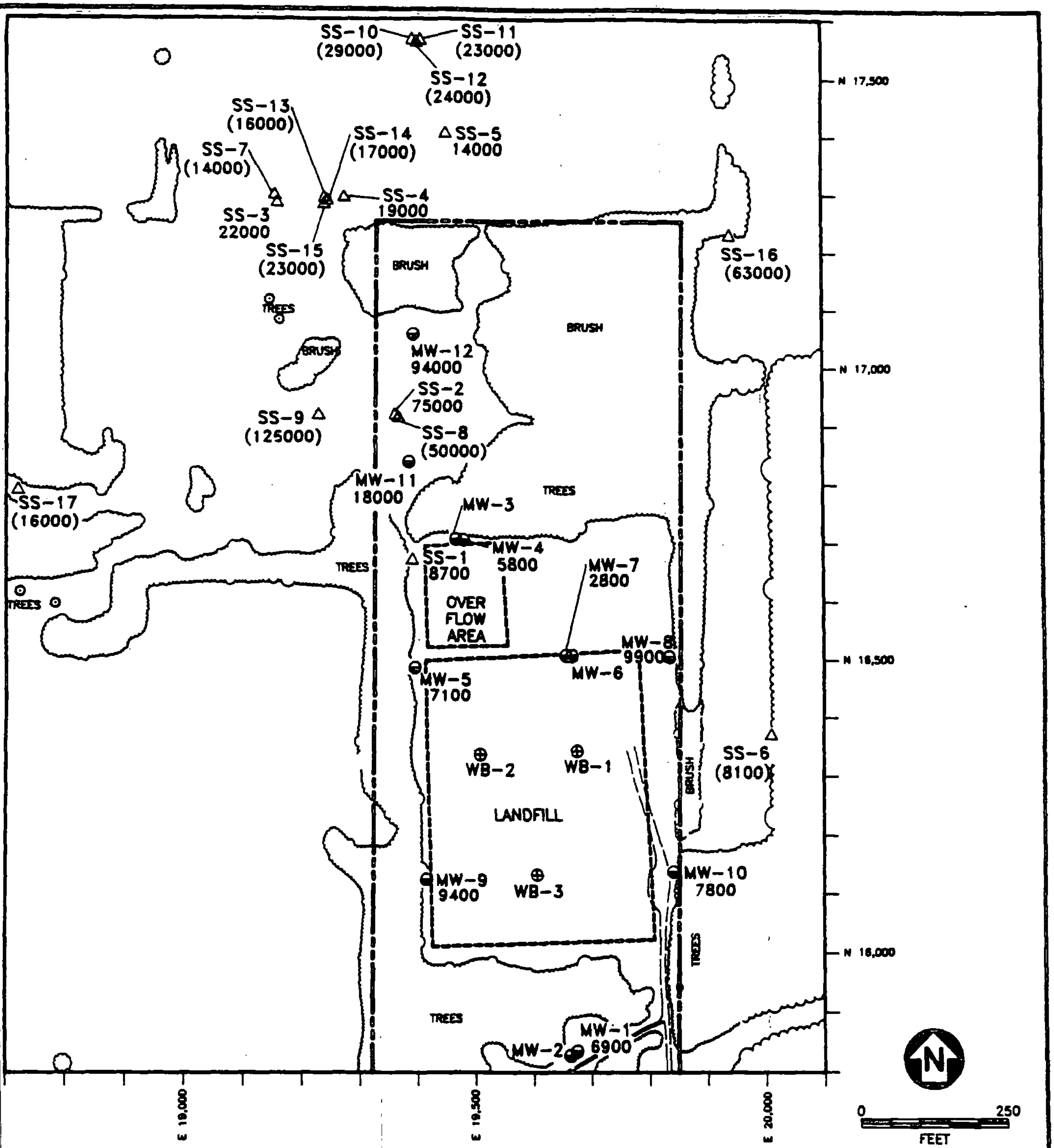
FIGURE 6-12
CONCENTRATION OF
COPPER
IN SOIL AND SEDIMENT
AMERT SITE INVESTIGATION
PREPARED FOR
WHIRLPOOL CORPORATION
CLYDE, OHIO

Do Not Scale This Drawing

DRAWING NUMBER 446493-A62

DRAFT BY	DRAFT CHK	PROJ. CHK	APPRV. BY	
JEA 3/16/90	12/12/90	JMB 11-12-90	#3 11-12-90	

Do Not Scale This Drawing



EXPLANATION

- MONITORING WELL (MW) *
- WASTE BORING (WB)
- SURFACE SOIL (SS) SAMPLING LOCATION
- 7100 IRON CONCENTRATION (mg/Kg) DECEMBER 1989
- (8100) IRON CONCENTRATION (mg/Kg) APRIL 1990
- PROPERTY LINE
- PERIMETER OF LANDFILL
- UNPAVED ROAD
- TREES OR BRUSH

* SOIL SAMPLE COLLECTED FROM BORING FOR WELL.

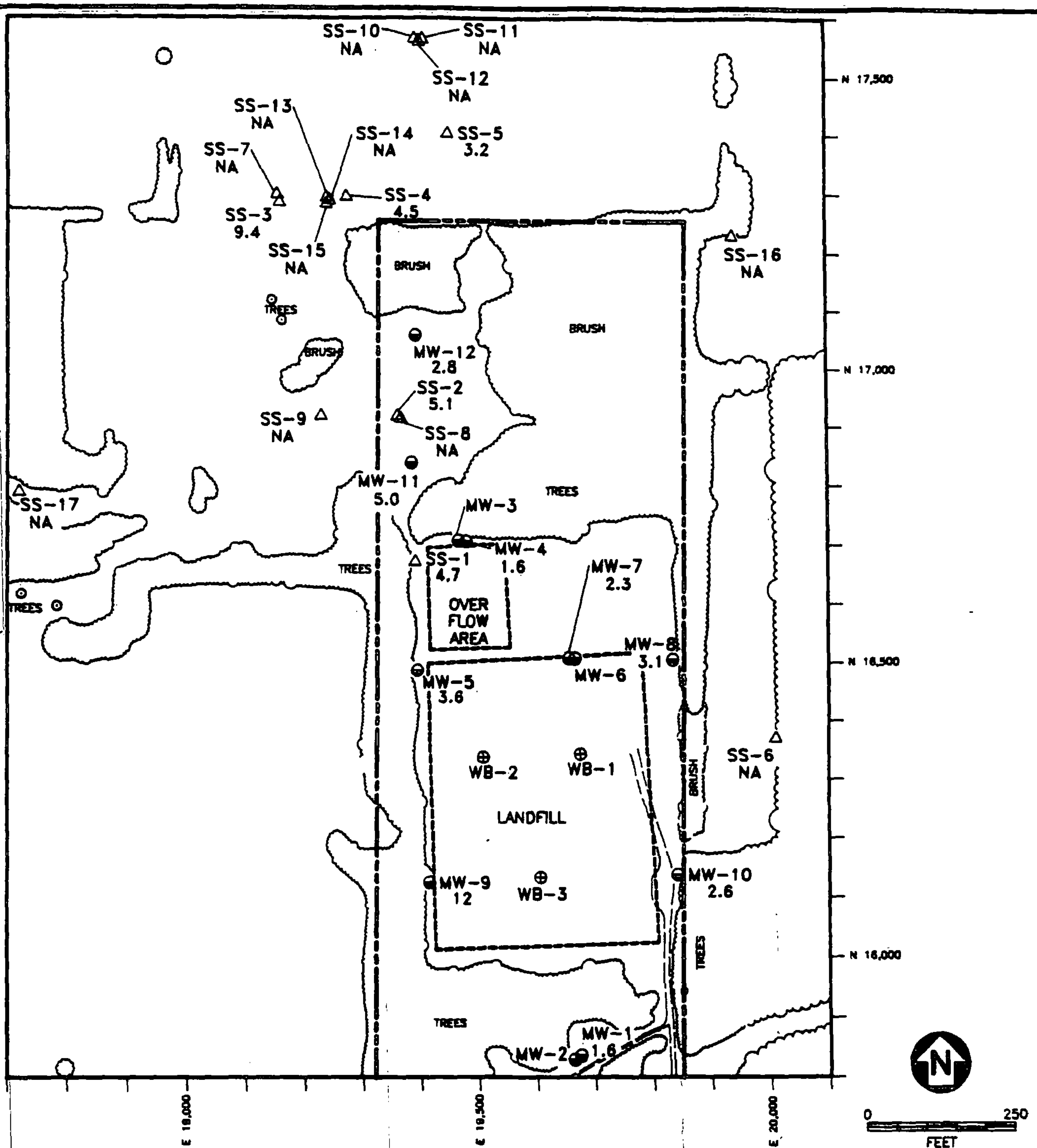
FIGURE 6-13

CONCENTRATION OF IRON IN SOIL AND SEDIMENT AMERT SITE INVESTIGATION

PREPARED FOR

WHIRLPOOL CORPORATION CLYDE, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION



EXPLANATION

- MONITORING WELL (MW)
- WASTE BORING (WB)
- SURFACE SOIL (SS) SAMPLING LOCATION
- 12 LEAD CONCENTRATION (mg/Kg) DECEMBER 1989
- NA NOT ANALYZED
- PROPERTY LINE
- PERIMETER OF LANDFILL
- UNPAVED ROAD
- TREES OR BRUSH

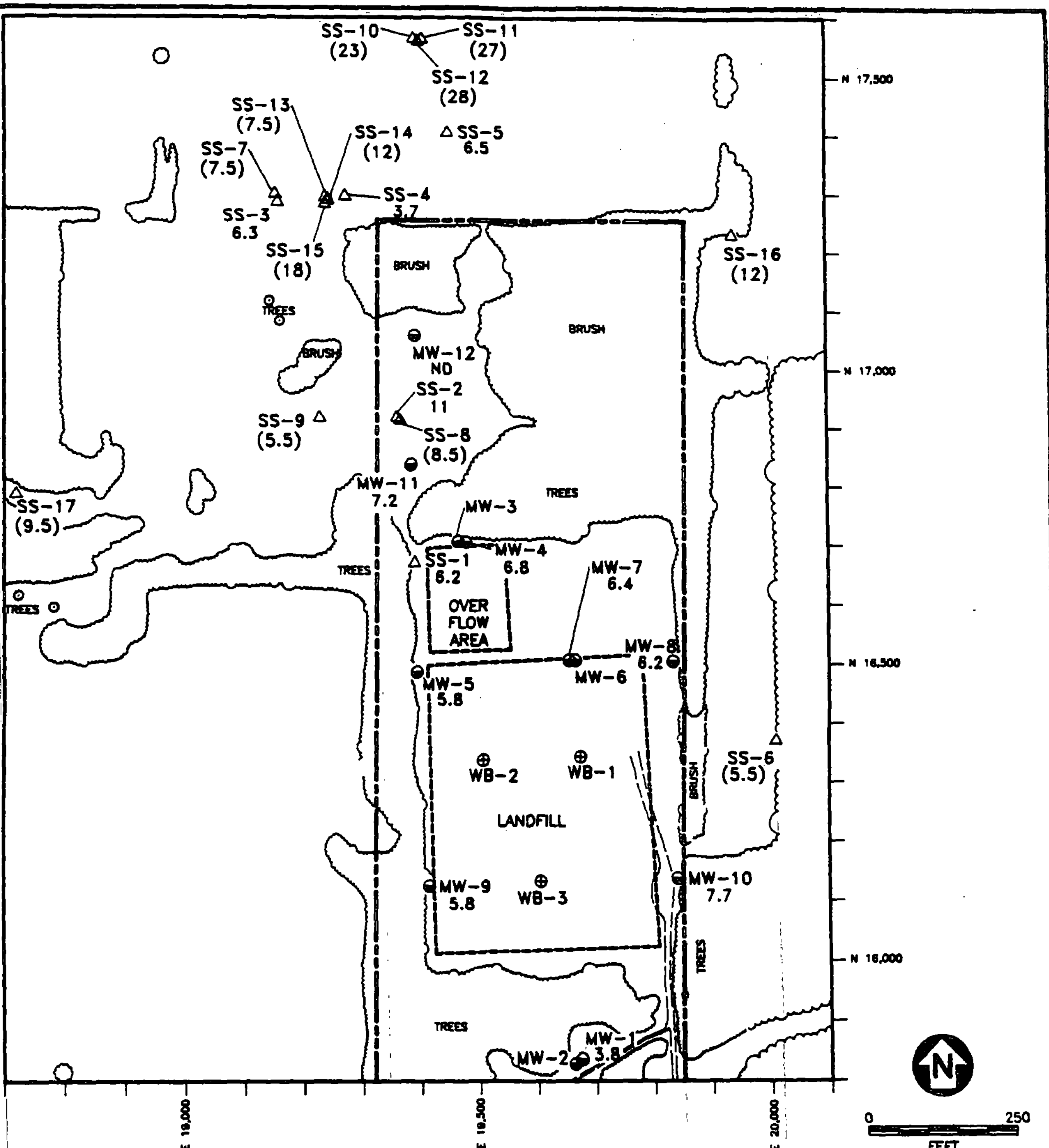
* SOIL SAMPLE COLLECTED FROM BORING FOR WELL

FIGURE 6-14
CONCENTRATION OF
LEAD
IN SOIL AND SEDIMENT
AMERT SITE INVESTIGATION
PREPARED FOR
WHIRLPOOL CORPORATION
CLYDE, OHIO

DRAWING NUMBER 446493-A67

DRAFT BY	JEA 3/16/90
DRAFT CHK	
PROJ. CHK	11-12-90
APPRV. BY	11-12-90

Do Not Scale This Drawing



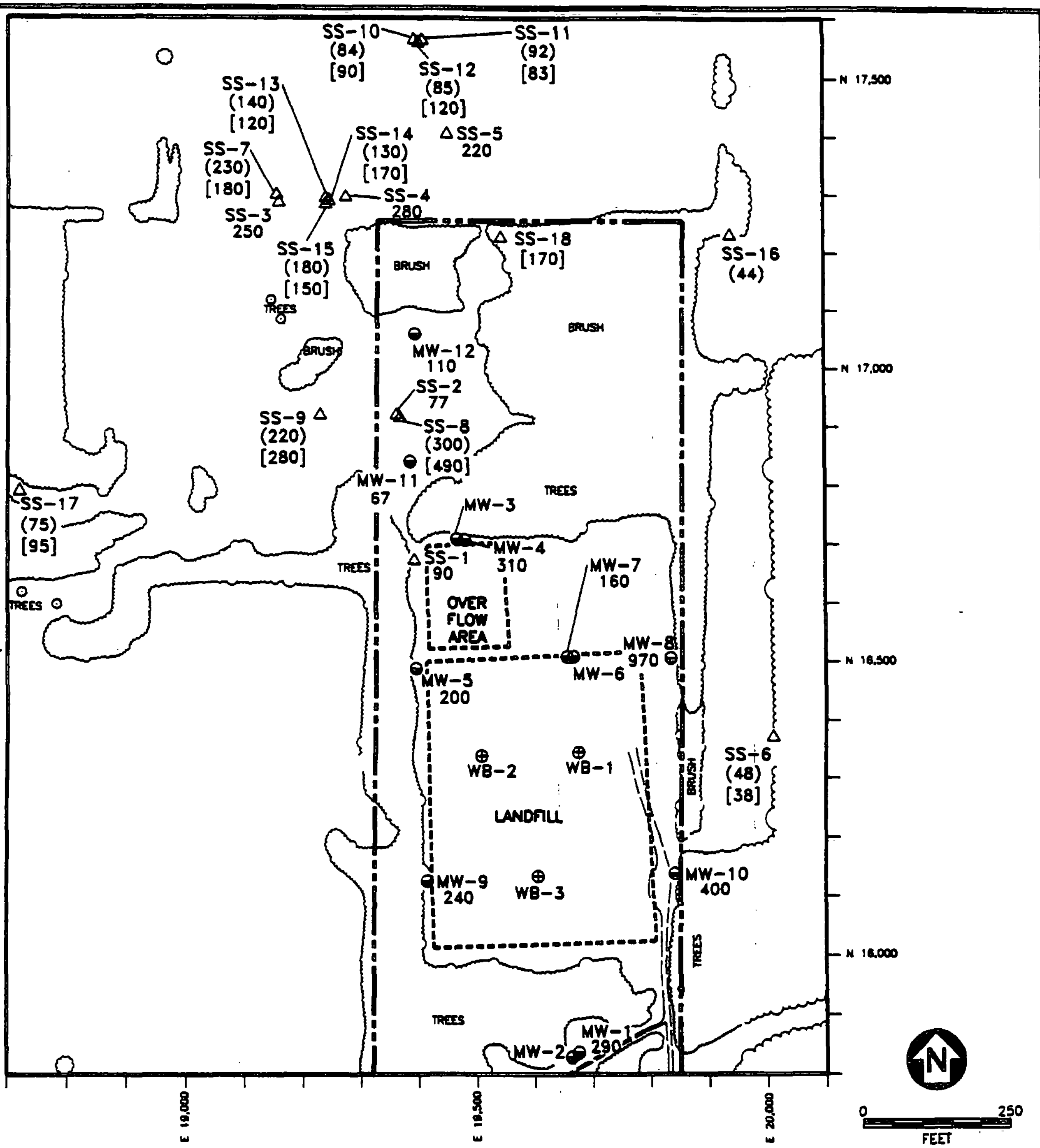
EXPLANATION

- MONITORING WELL (MW)
- WASTE BORING (WB)
- SURFACE SOIL (SS) SAMPLING LOCATION
- 11 NICKEL CONCENTRATION (mg/Kg) DECEMBER 1989
- (9.5) NICKEL CONCENTRATION (mg/Kg) APRIL 1990
- ND NICKEL CONCENTRATION BELOW DETECTION LIMIT
- PROPERTY LINE
- PERIMETER OF LANDFILL
- UNPAVED ROAD
- TREES OR BRUSH
- * SOIL SAMPLE COLLECTED FROM BORING FOR WELL.

FIGURE 6-15
CONCENTRATION OF
NICKEL
IN SOIL AND SEDIMENT
AMERT SITE INVESTIGATION
PREPARED FOR
WHIRLPOOL CORPORATION
CLYDE, OHIO

DRAWING NUMBER 446493-A64

DRAFT BY	JEA 3/16/90	DRAFT CHK	11/1990	PROJ. CHK	11-12-90	APPRV. BY	11-12-90



EXPLANATION

- MONITORING WELL (MW)
- WASTE BORING (WB)
- SURFACE SOIL (SS) SAMPLING LOCATION
- 77 PHOSPHORUS CONCENTRATION (mg/Kg) DECEMBER 1989
- (48) SODIUM CONCENTRATION (mg/Kg) APRIL 1990
- [38] SODIUM CONCENTRATION (mg/Kg) AUGUST 1990
- PROPERTY LINE
- PERIMETER OF LANDFILL
- UNPAVED ROAD
- TREES OR BRUSH
- * SOIL SAMPLE COLLECTED FROM BORING FOR WELL

FIGURE 6-16

CONCENTRATION OF
PHOSPHORUS/SODIUM
IN SOIL AND SEDIMENT
AMERT SITE INVESTIGATION

PREPARED FOR

WHIRLPOOL CORPORATION
CLYDE, OHIO

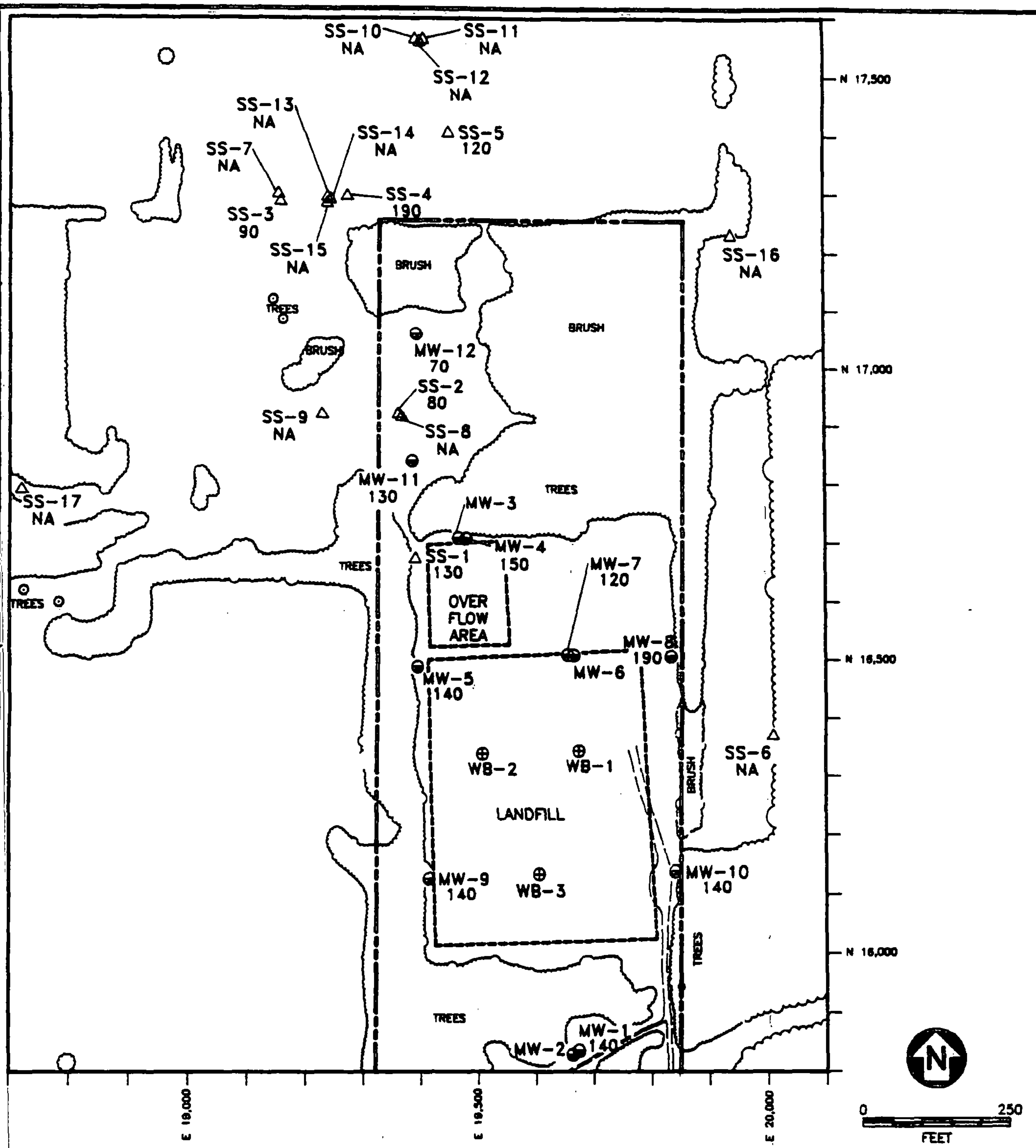
DRAWING NUMBER 446493-A69

DRAFT BY | JEA 3/16/90 | DRAFT CHK | RCS 11/12/90 | PROJ. CHK | MS 11-12-90 | APPRV. BY | MS 11-12-90

Do Not Scale This Drawing

DRAWING NUMBER 446493-A71

DRAFT BY	JEA 3/16/90	DRAFT CHK	PROJ. CHK	APPRV. BY

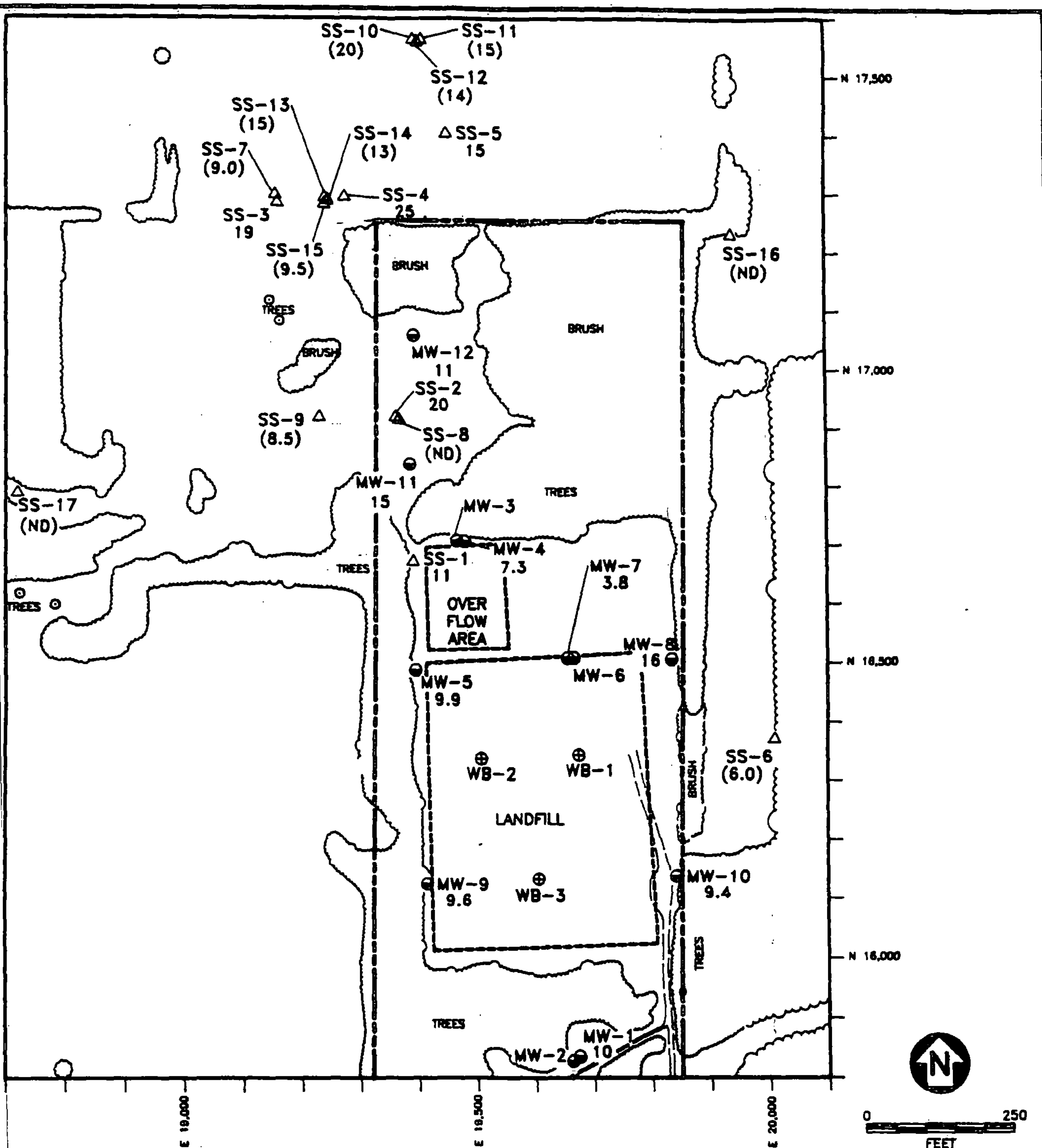


EXPLANATION

- MONITORING WELL (MW)
- WASTE BORING (WB)
- SURFACE SOIL (SS) SAMPLING LOCATION
- 70 TITANIUM CONCENTRATION (mg/Kg) DECEMBER 1989
- NA NOT ANALYZED
- PROPERTY LINE
- PERIMETER OF LANDFILL
- UNPAVED ROAD
- TREES OR BRUSH

* SOIL SAMPLE COLLECTED FROM BORING FOR WELL.

FIGURE 6-17
CONCENTRATION OF
TITANIUM
IN SOIL AND SEDIMENT
AMERT SITE INVESTIGATION
PREPARED FOR
WHIRLPOOL CORPORATION
CLYDE, OHIO



EXPLANATION

- MONITORING WELL (MW) *
- WASTE BORING (WB)
- SURFACE SOIL (SS) SAMPLING LOCATION
- 11 VANADIUM CONCENTRATION (mg/Kg) DECEMBER 1989
- (13) VANADIUM CONCENTRATION (mg/Kg) APRIL 1990
- ND VANADIUM CONCENTRATION BELOW DETECTION LIMIT
- PROPERTY LINE
- PERIMETER OF LANDFILL
- UNPAVED ROAD
- TREES OR BRUSH

* SOIL SAMPLE COLLECTED FROM BORING FOR WELL.

FIGURE 6-18
CONCENTRATION OF
VANADIUM
IN SOIL AND SEDIMENT
AMERT SITE INVESTIGATION
PREPARED FOR
WHIRLPOOL CORPORATION
CLYDE, OHIO

DRAWING NUMBER 446493-A68
APPRV. BY
PROJ. CHK
DRAFT CHK
DRAFT BY JEA 3/16/90

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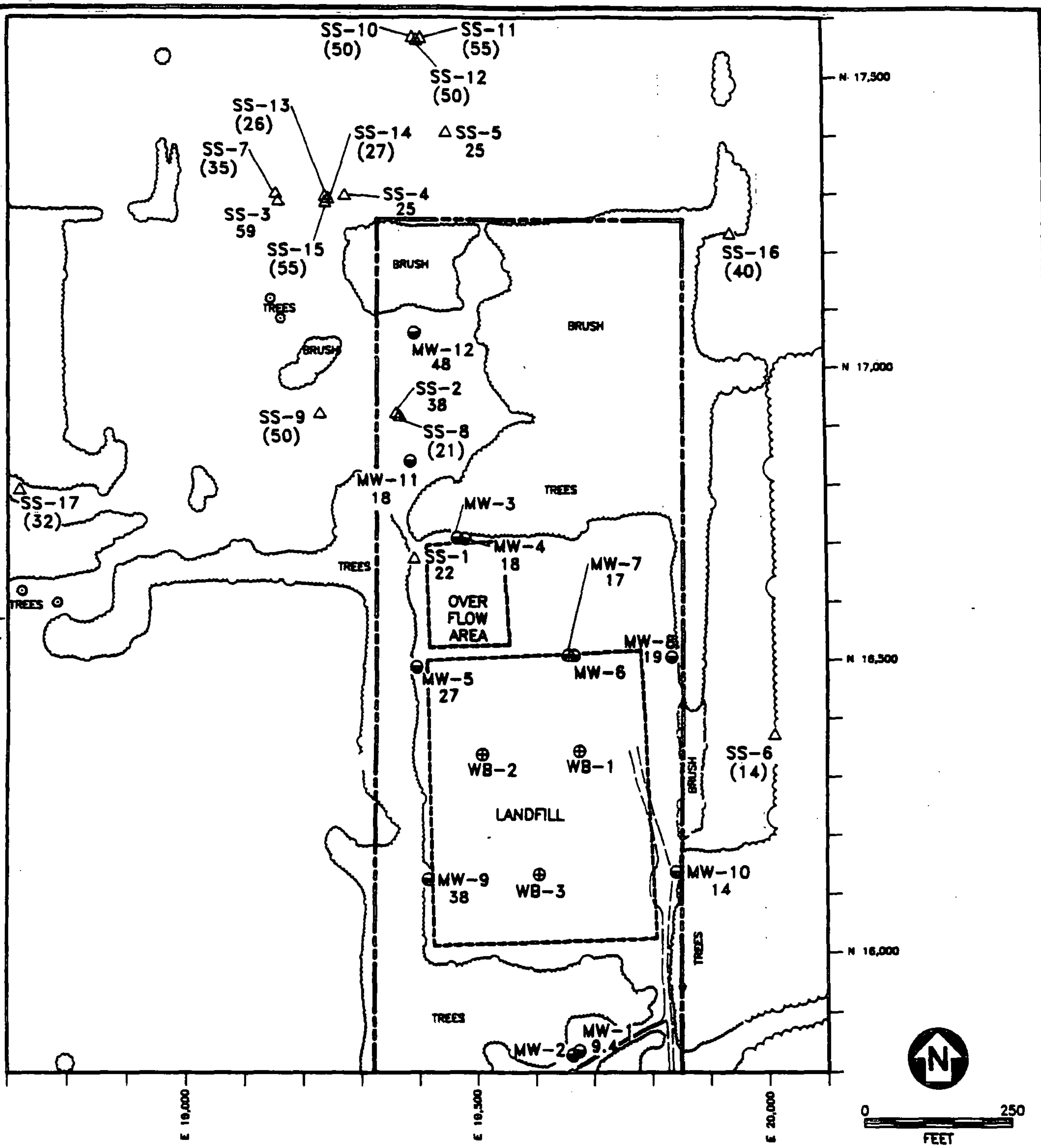


EXPLANATION

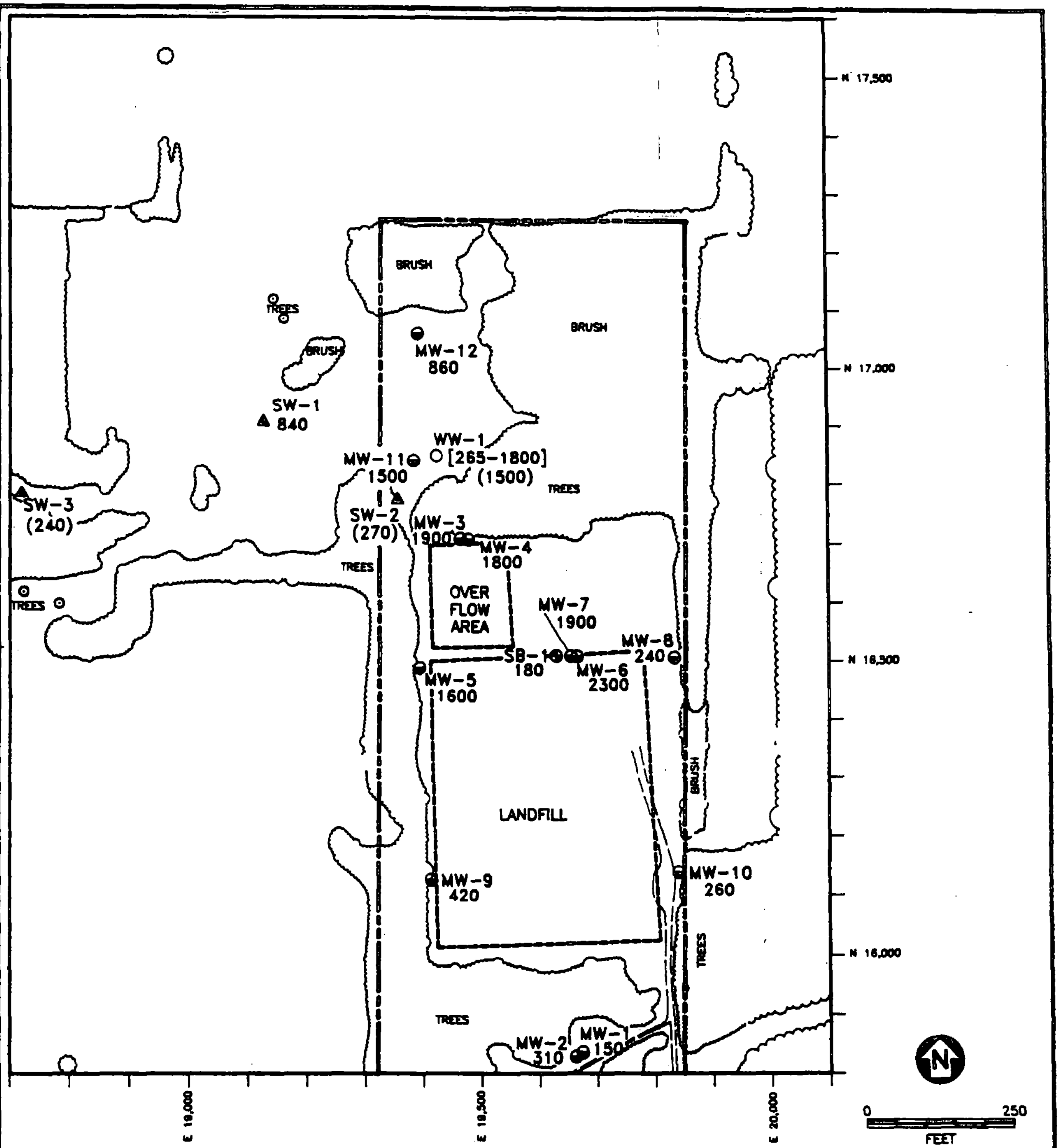
- MONITORING WELL (MW) *
- WASTE BORING (WB)
- SURFACE SOIL (SS) SAMPLING LOCATION
- 18 ZINC CONCENTRATION (mg/Kg) DECEMBER 1989
- (14) ZINC CONCENTRATION (mg/Kg) APRIL 1990
- PROPERTY LINE
- PERIMETER OF LANDFILL
- UNPAVED ROAD
- TREES OR BRUSH

* SOIL SAMPLE COLLECTED FROM BORING FOR WELL.

FIGURE 6-19
CONCENTRATION OF
ZINC
IN SOIL AND SEDIMENT
AMERT SITE INVESTIGATION
PREPARED FOR
WHIRLPOOL CORPORATION
CLYDE, OHIO

DRAWING NUMBER 446493-A63

DRAFT BY	DRAFT CHK	PROJ. CHK	APPRV. BY
JEA 3/16/90	[illegible]	[illegible]	[illegible] 11-12-90



EXPLANATION

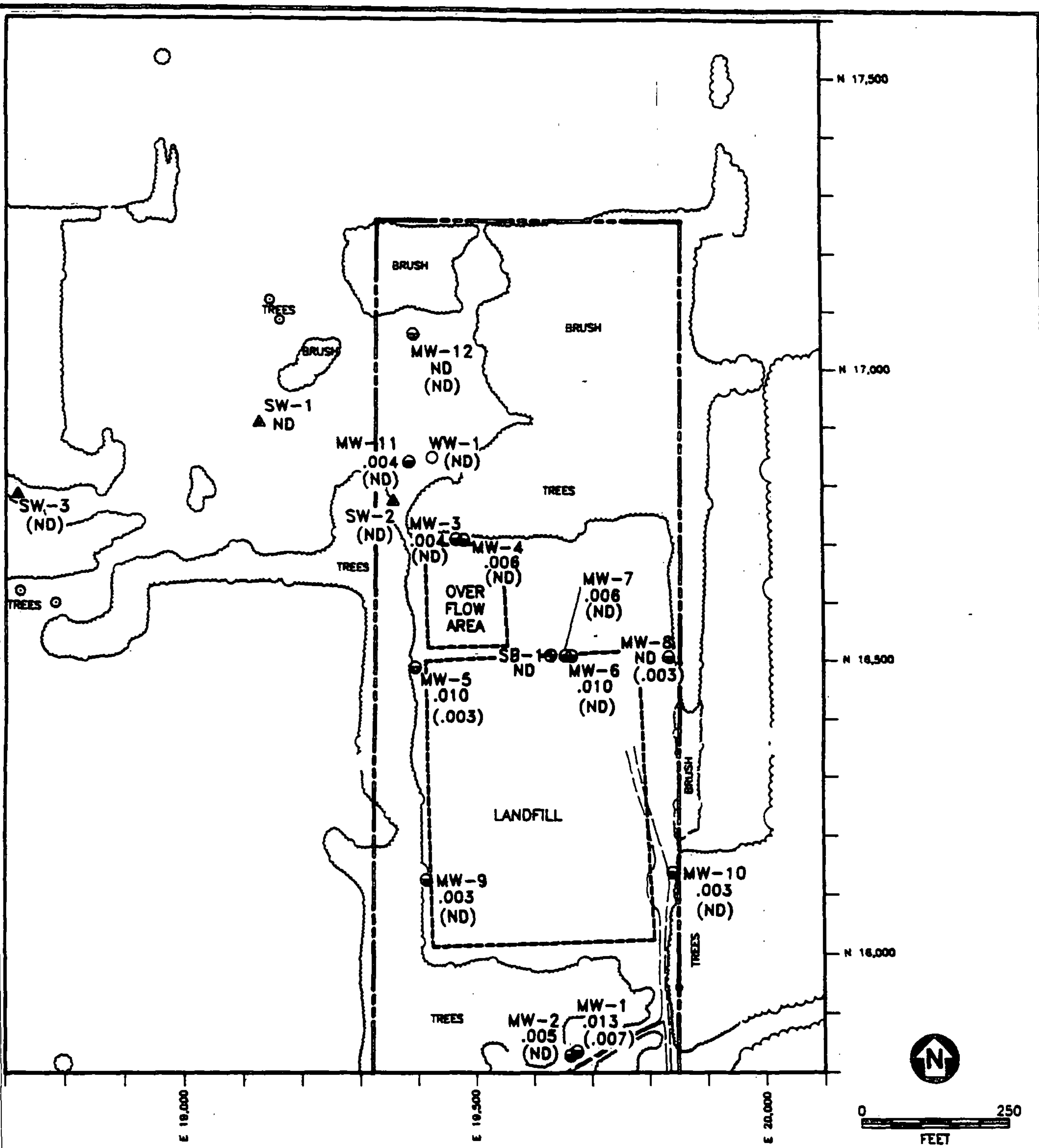
- MONITORING WELL (MW)
- DEEP MONITORING WELL (SB)
- SHALLOW DUG WELL (WW)
- SURFACE WATER (SW) SAMPLING LOCATION
- 860 ALKALINITY CONCENTRATION (mg/L) DECEMBER 1989
- (270) ALKALINITY CONCENTRATION (mg/L) APRIL 1990
- [265-1800] RANGE OF CONCENTRATION FROM PREVIOUS ANALYSIS (mg/L)
- PROPERTY LINE
- PERIMETER OF LANDFILL
- UNPAVED ROAD
- TREES OR BRUSH

FIGURE 6-20

CONCENTRATION OF
ALKALINITY
IN WATER
AMERT SITE INVESTIGATION
PREPARED FOR
WHIRLPOOL CORPORATION
CLYDE, OHIO

DRAFT BY	JEA 3/16/90	DRAFT CHK	SCS 11/12/90	PROJ. CHK	MB 11-12-90	APPRV. BY	MB 11-12-90	DRAWING NUMBER	446493-A52

Do Not Scale This Drawing



EXPLANATION

- MONITORING WELL (MW)
- STRATIGRAPHIC BORING (SB)
- SHALLOW DUG WELL (WW)
- SURFACE WATER (SW) SAMPLING LOCATION
- .010 ARSENIC CONCENTRATION (mg/L) DECEMBER 1989
- (.003) ARSENIC CONCENTRATION (mg/L) APRIL 1990
- ND ARSENIC CONCENTRATION BELOW DETECTION LIMIT
- PROPERTY LINE
- PERIMETER OF LANDFILL
- UNPAVED ROAD
- TREES OR BRUSH

FIGURE 6-21

CONCENTRATION OF
ARSENIC
IN WATER
AMERT SITE INVESTIGATION

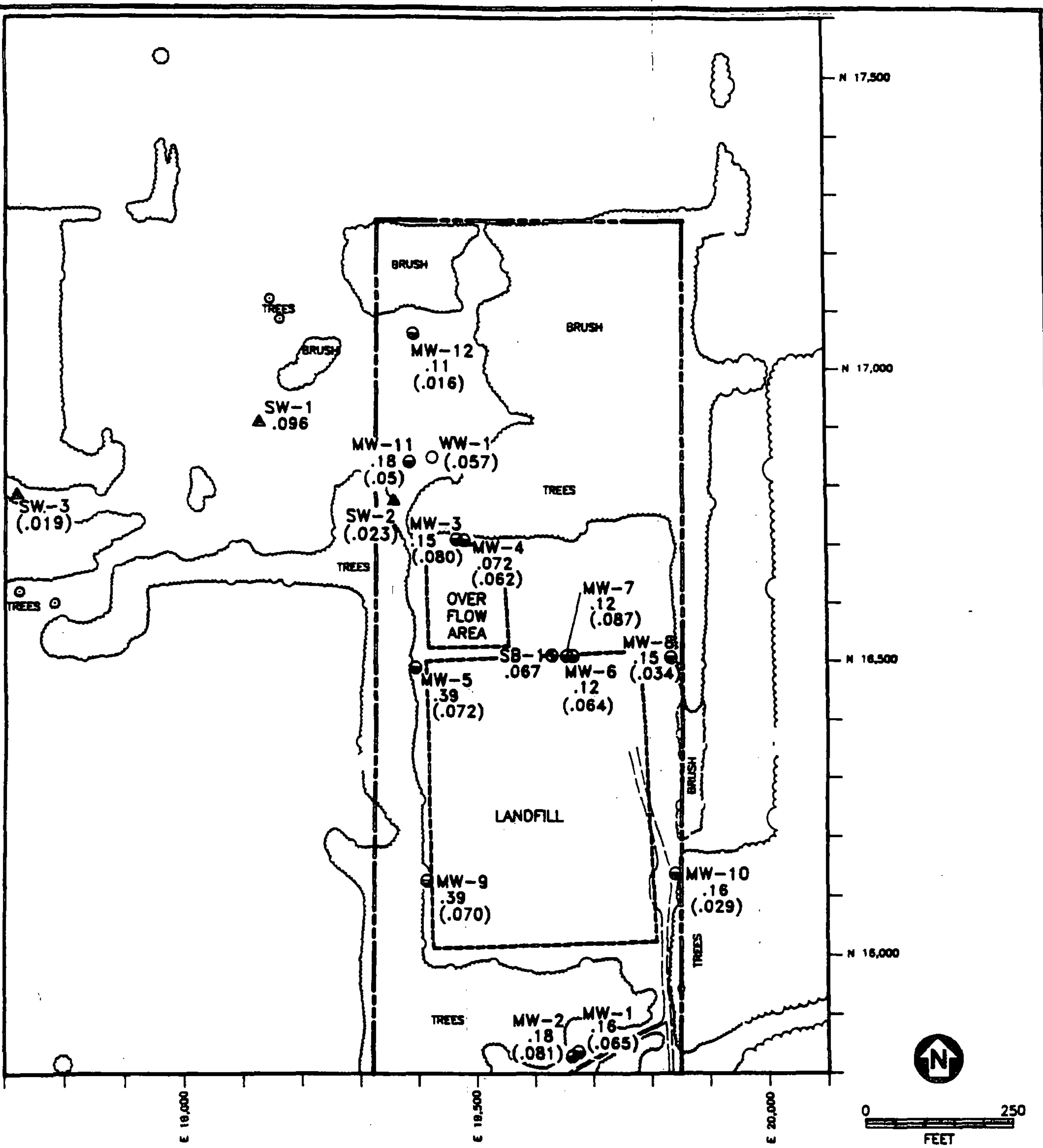
PREPARED FOR

WHIRLPOOL CORPORATION
CLYDE, OHIO

DRAWING NUMBER 446493-A56

DRAFT BY	DRAFT CHK	PROJ. CHK	APPRV. BY
JEA 3/13/90		11-12-90	11-12-90

Do Not Scale This Drawing



EXPLANATION

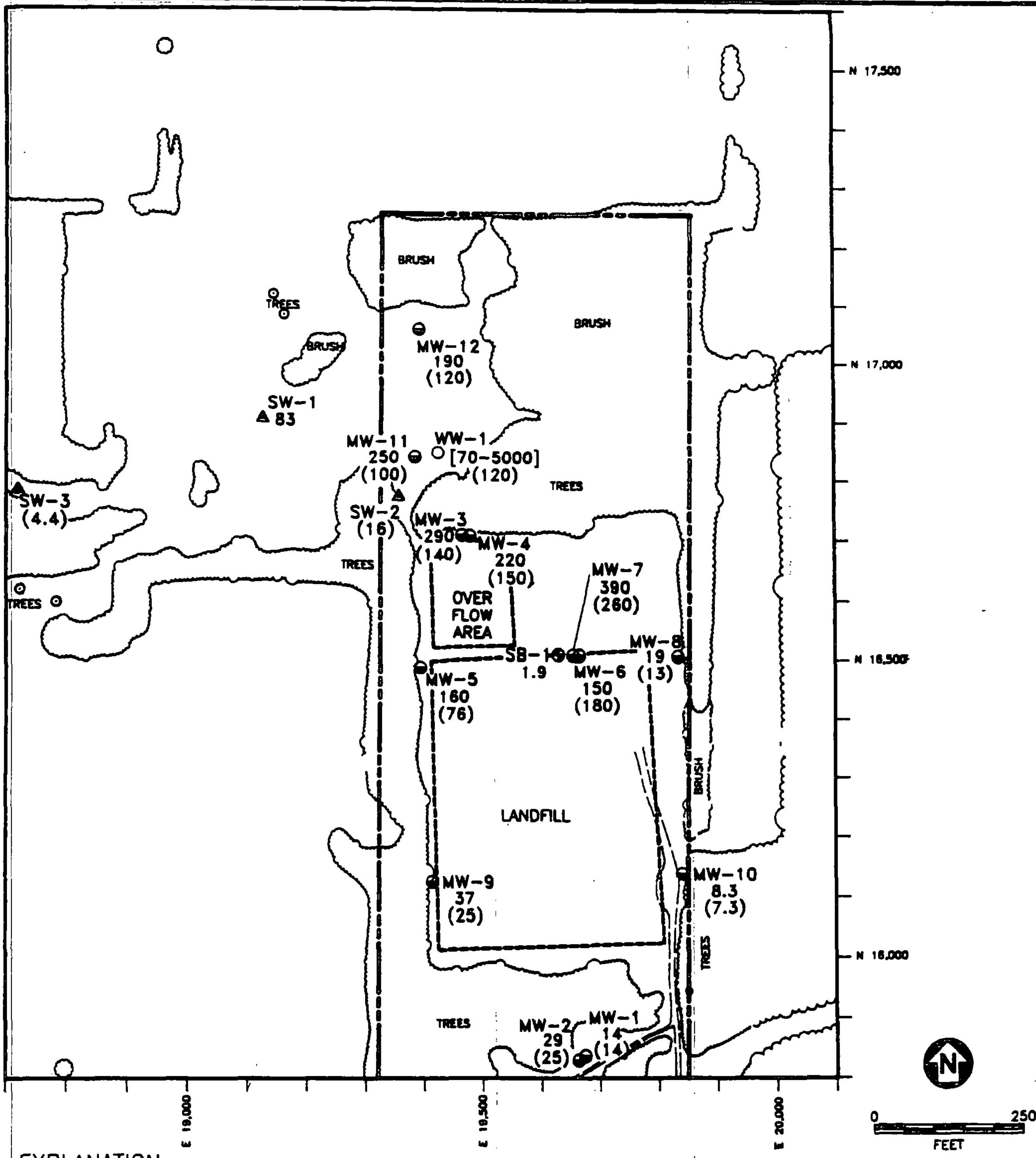
- MONITORING WELL (MW)
- STRATIGRAPHIC BORING (SB)
- SHALLOW DUG WELL (WW)
- SURFACE WATER (SW) SAMPLING LOCATION
- .15 BARIUM CONCENTRATION (mg/L) DECEMBER 1989
- (.034) BARIUM CONCENTRATION (mg/L) APRIL 1990
- PROPERTY LINE
- PERIMETER OF LANDFILL
- UNPAVED ROAD
- TREES OR BRUSH

FIGURE 6-22
CONCENTRATION OF
BARIUM
IN WATER
AMERT SITE INVESTIGATION
PREPARED FOR
WHIRLPOOL CORPORATION
CLYDE, OHIO

DRAWING NUMBER 446493-A53

DRAFT BY	JEA 3/16/90
DRAFT CHK	
PROJ. CHK	11/12/90
APPRV. BY	11-12-90

Do Not Scale This Drawing



EXPLANATION

- MONITORING WELL (MW)
- STRATIGRAPHIC BORING (SB)
- SHALLOW DUG WELL (WW)
- SURFACE WATER (SW) SAMPLING LOCATION
- 8.3 BORON CONCENTRATION (mg/L) DECEMBER 1989
- (7.3) BORON CONCENTRATION (mg/L) APRIL 1990
- [70-5000] RANGE OF CONCENTRATION FROM PREVIOUS ANALYSIS
- PROPERTY LINE
- PERIMETER OF LANDFILL
- UNPAVED ROAD
- TREES OR BRUSH

FIGURE 6-23

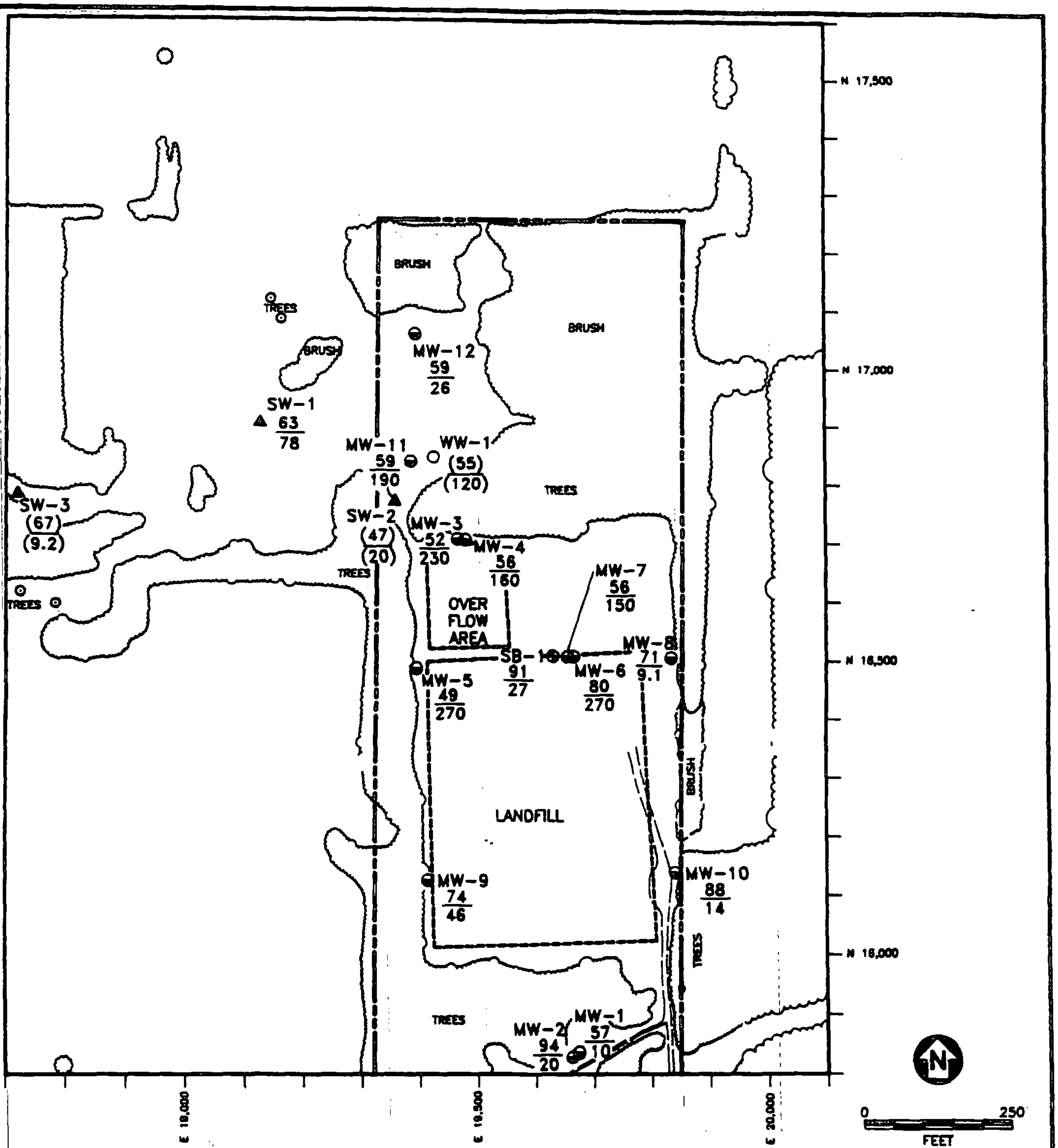
CONCENTRATION OF
BORON
IN WATER
AMERT SITE INVESTIGATION

PREPARED FOR

WHIRLPOOL CORPORATION
CLYDE, OHIO

DRAFT BY	JEA 3/16/90	DRAFT CHK	RPS 11/12/90	PROJ. CHK	MS 11-12-90	APPRV. BY	MS 11-12-90	DRAWING NUMBER	446493-A45

Do Not Scale This Drawing



EXPLANATION

- MONITORING WELL (MW)
- STRATIGRAPHIC BORING (SB)
- SHALLOW DUG WELL (WW)
- SURFACE WATER (SW) SAMPLING LOCATION
- 59 — CALCIUM CONCENTRATION (mg/L)
- 190 — MAGNESIUM CONCENTRATION (mg/L) DECEMBER 1989
- (67) — CALCIUM CONCENTRATION (mg/L)
- (9.2) — MAGNESIUM CONCENTRATION (mg/L) APRIL 1990
- PROPERTY LINE
- PERIMETER OF LANDFILL
- UNPAVED ROAD
- TREES OR BRUSH

FIGURE 6-24

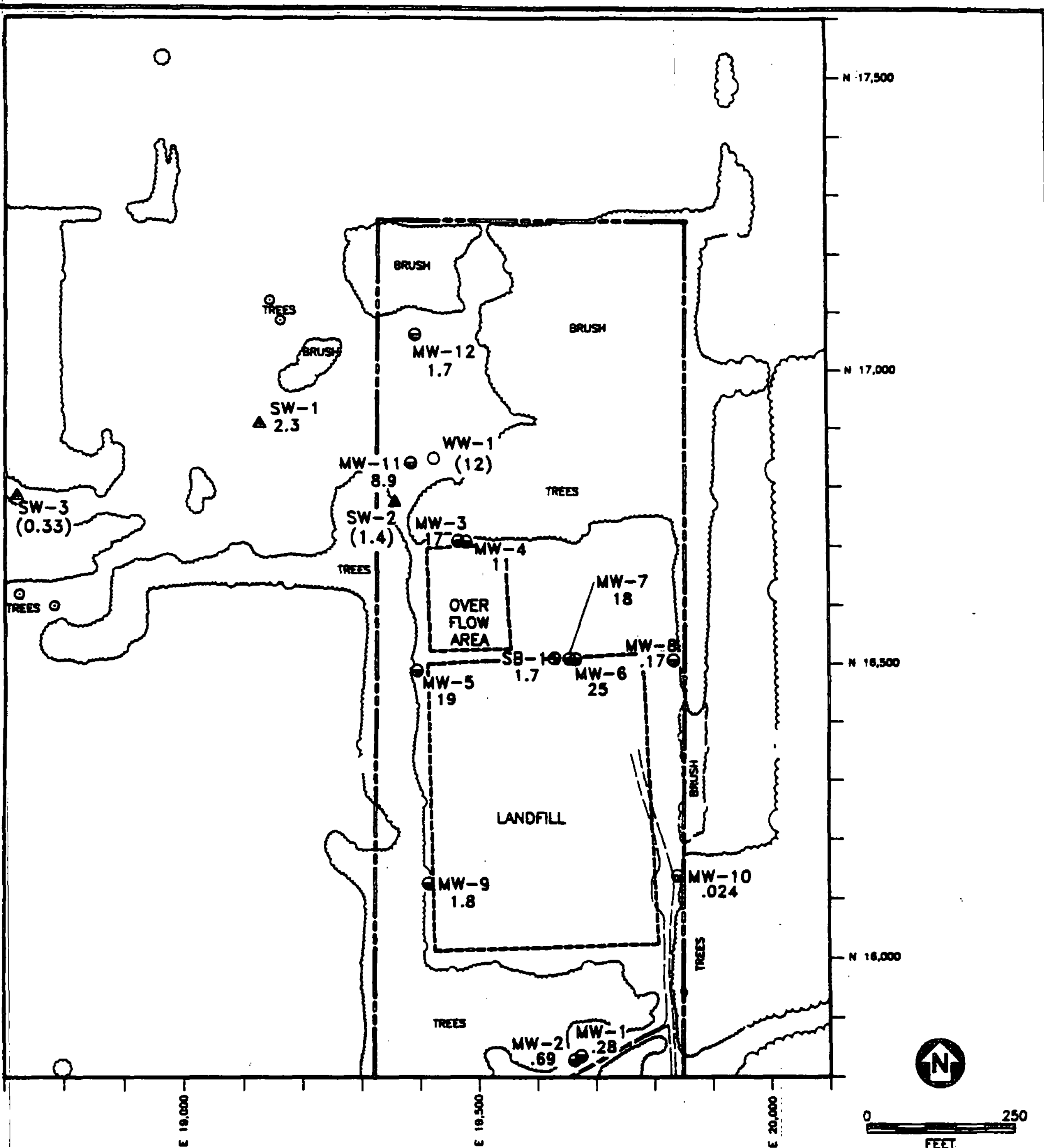
CONCENTRATION OF
CALCIUM/MAGNESIUM
IN WATER
AMERT SITE INVESTIGATION

PREPARED FOR

WHIRLPOOL CORPORATION
CLYDE, OHIO

DRAFT BY | JEA 3/15/90 | DRAFT CHK | [illegible] 11/12/90 | PROJ. CHK | MS 11-12-90 | APPRV. BY | MS 11-12-90 | DRAWING NUMBER 446493-A49

Do Not Scale This Drawing



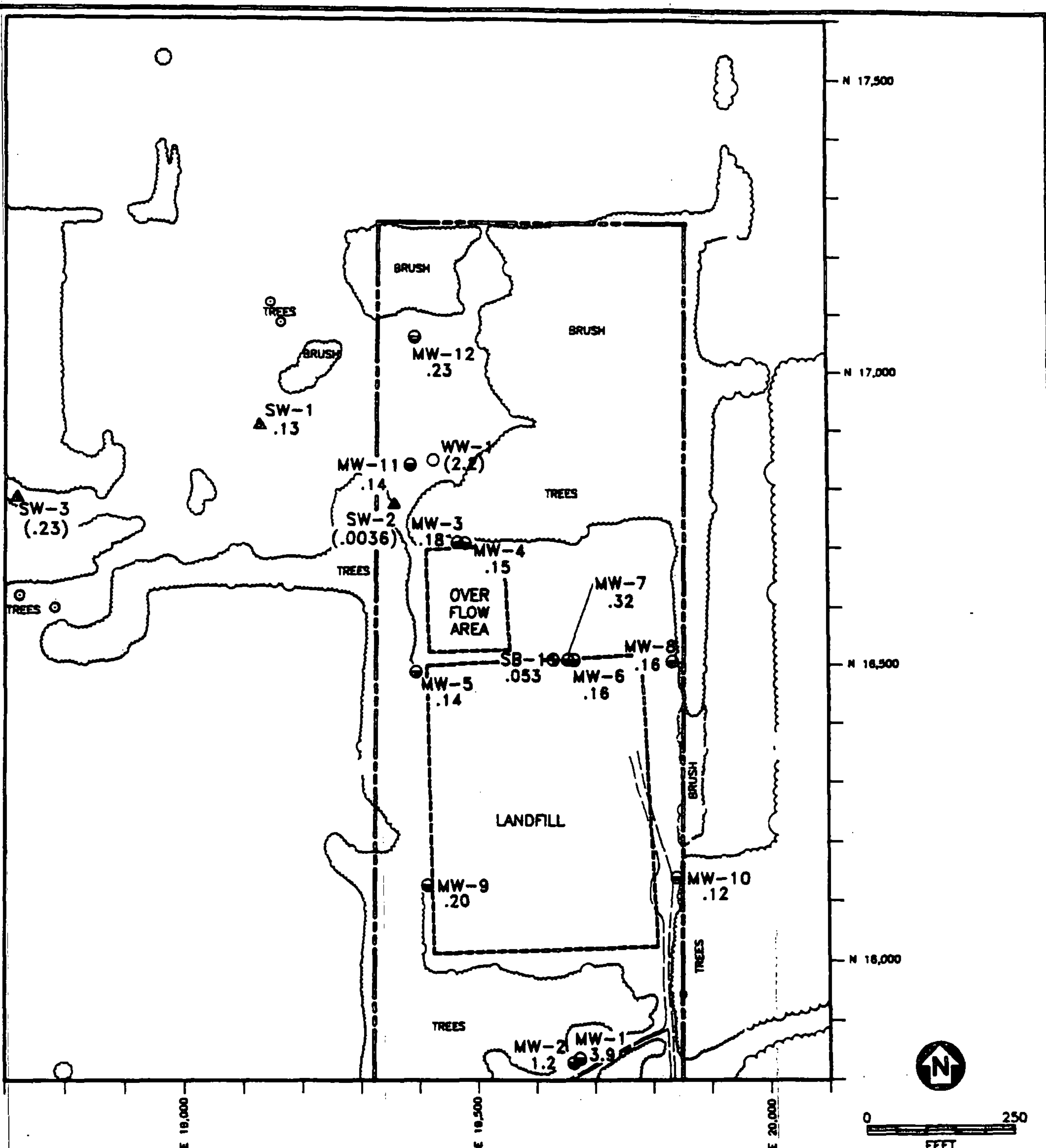
EXPLANATION

- MONITORING WELL (MW)
- STRATIGRAPHIC BORING (SB)
- SHALLOW DUG WELL (WW)
- SURFACE WATER (SW) SAMPLING LOCATION
- 8.9 FLUORIDE CONCENTRATION (mg/L) DECEMBER 1989
- (1.4) FLUORIDE CONCENTRATION (mg/L) APRIL 1990
- PROPERTY LINE
- PERIMETER OF LANDFILL
- UNPAVED ROAD
- TREES OR BRUSH

FIGURE 6-25
CONCENTRATION OF
FLUORIDE
IN WATER
AMERT SITE INVESTIGATION
PREPARED FOR
WHIRLPOOL CORPORATION
CLYDE, OHIO

DRAFT BY	DRAFT CHK	PROJ. CHK	APPRV. BY	DRAWING NUMBER
JEA 3/15/90	CPS 11/12/90	MS 11-12-90	MS 11-12-90	446493-A46

Do Not Scale This Drawing



EXPLANATION

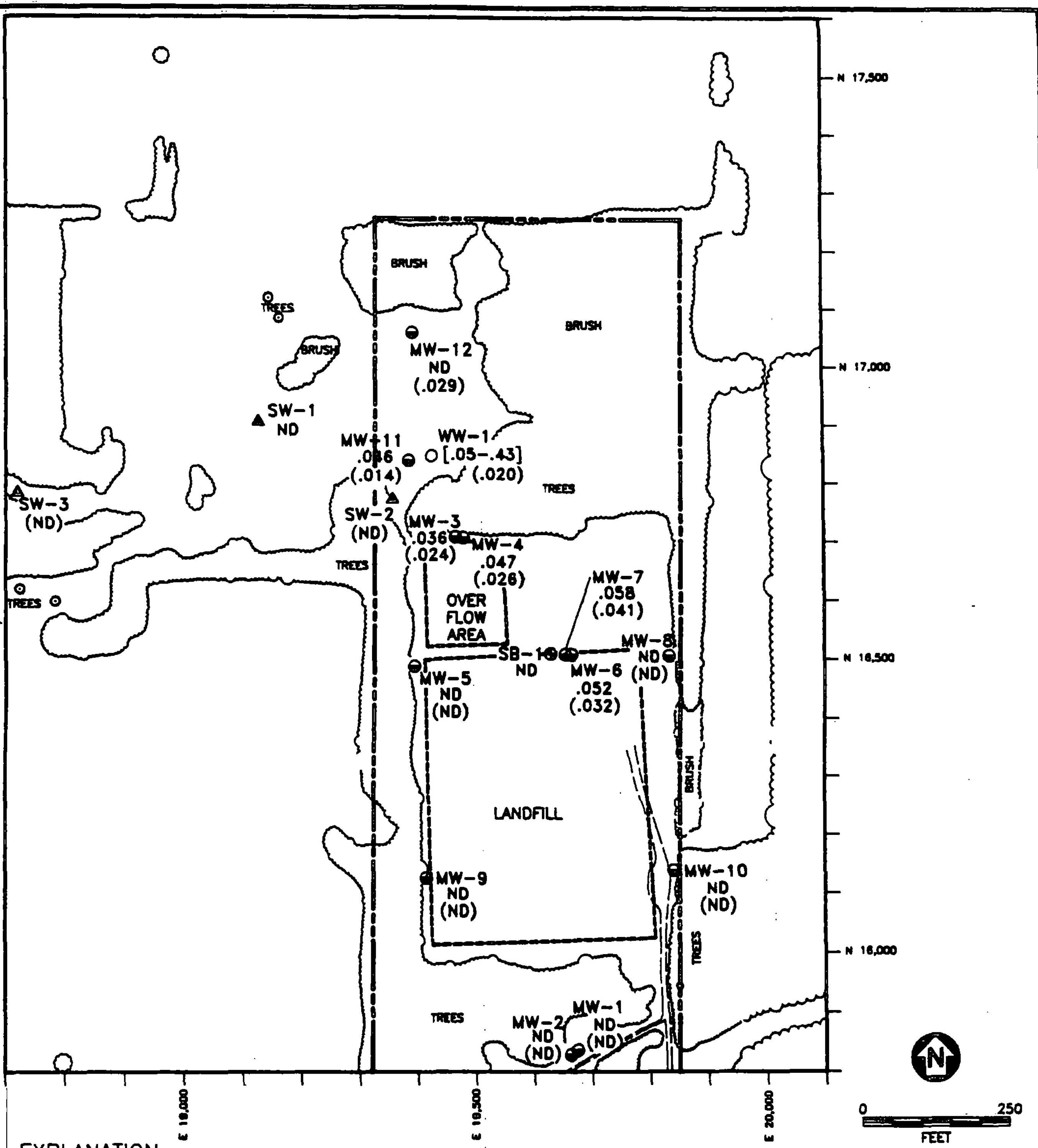
- MONITORING WELL (MW)
- STRATIGRAPHIC BORING (SB)
- SHALLOW DUG WELL (WW)
- SURFACE WATER (SW) SAMPLING LOCATION
- .15 IRON CONCENTRATION (mg/L) DECEMBER 1989
- (.23) IRON CONCENTRATION (mg/L) APRIL 1990
- PROPERTY LINE
- PERIMETER OF LANDFILL
- UNPAVED ROAD
- TREES OR BRUSH

FIGURE 6-26
CONCENTRATION OF
IRON
IN WATER
AMERT SITE INVESTIGATION
PREPARED FOR
WHIRLPOOL CORPORATION
CLYDE, OHIO

DRAFT BY	JEA 3/16/90	DRAFT CHK	PROJ. CHK	APPRV. BY	DRAWING NUMBER
			[illegible] 11/14/90	[illegible] 11-12-90	446493-A54

Do Not Scale This Drawing

DRAFT BY	JEA 3/16/90	DRAFT CHK	11/12/90	PROJ. CHK	MB 11-12-90	APPRV. BY	MB 11-12-90	DRAWING NUMBER 446493-A55

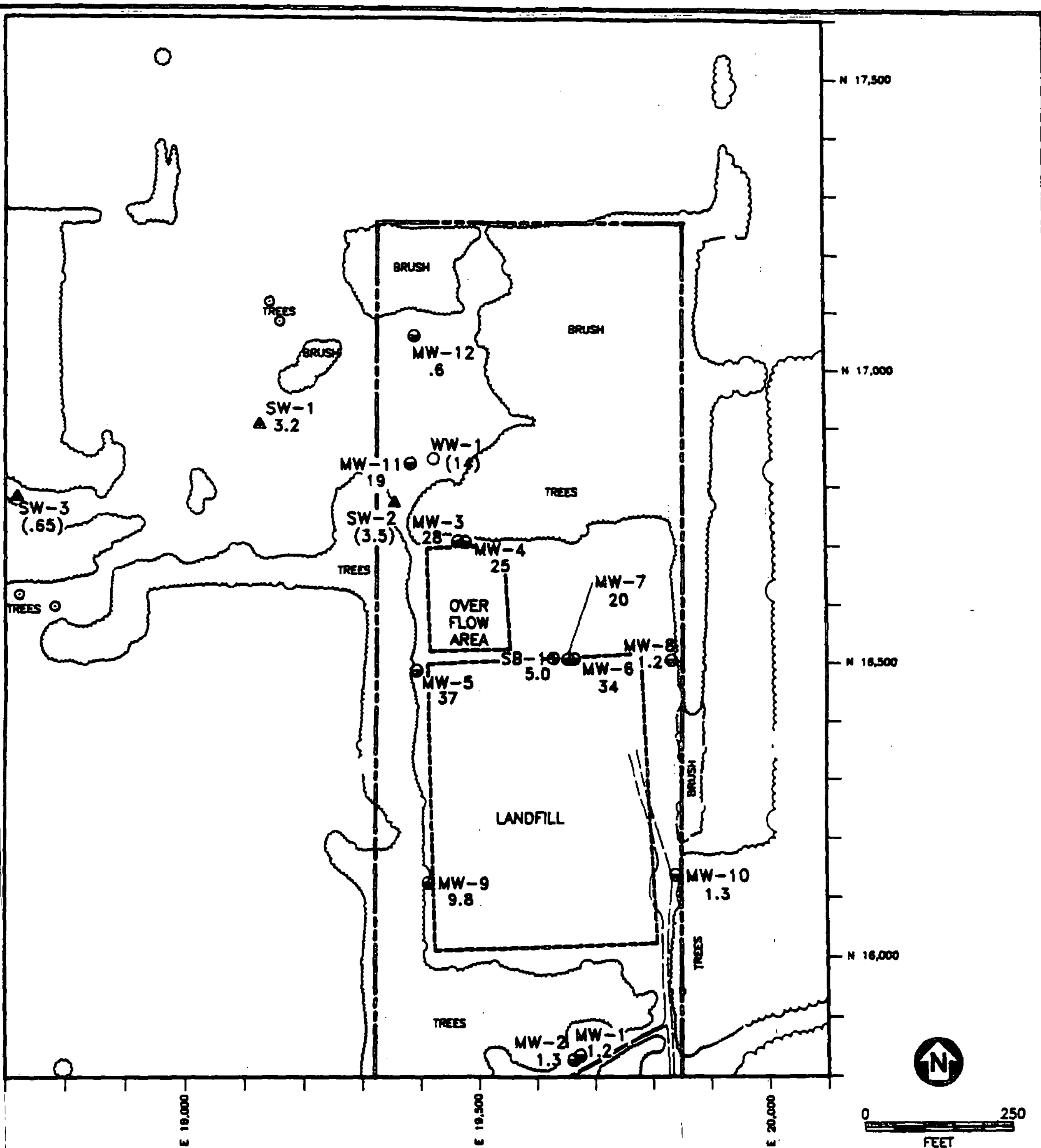


EXPLANATION

⊖	MONITORING WELL (MW)
⊕	STRATIGRAPHIC BORING (SB)
○	SHALLOW DUG WELL (WW)
▲	SURFACE WATER (SW) SAMPLING LOCATION
.046	NICKEL CONCENTRATION (mg/L) DECEMBER 1989
(.014)	NICKEL CONCENTRATION (mg/L) APRIL 1990
ND	NICKEL CONCENTRATION BELOW DETECTION LEVEL
[.05-.43]	RANGE OF CONCENTRATION FROM PREVIOUS ANALYSIS (mg/L)
	PROPERTY LINE
	PERIMETER OF LANDFILL
	UNPAVED ROAD
	TREES OR BRUSH

FIGURE 6-27

CONCENTRATION OF
NICKEL
IN WATER
AMERT SITE INVESTIGATION
PREPARED FOR
WHIRLPOOL CORPORATION
CLYDE, OHIO



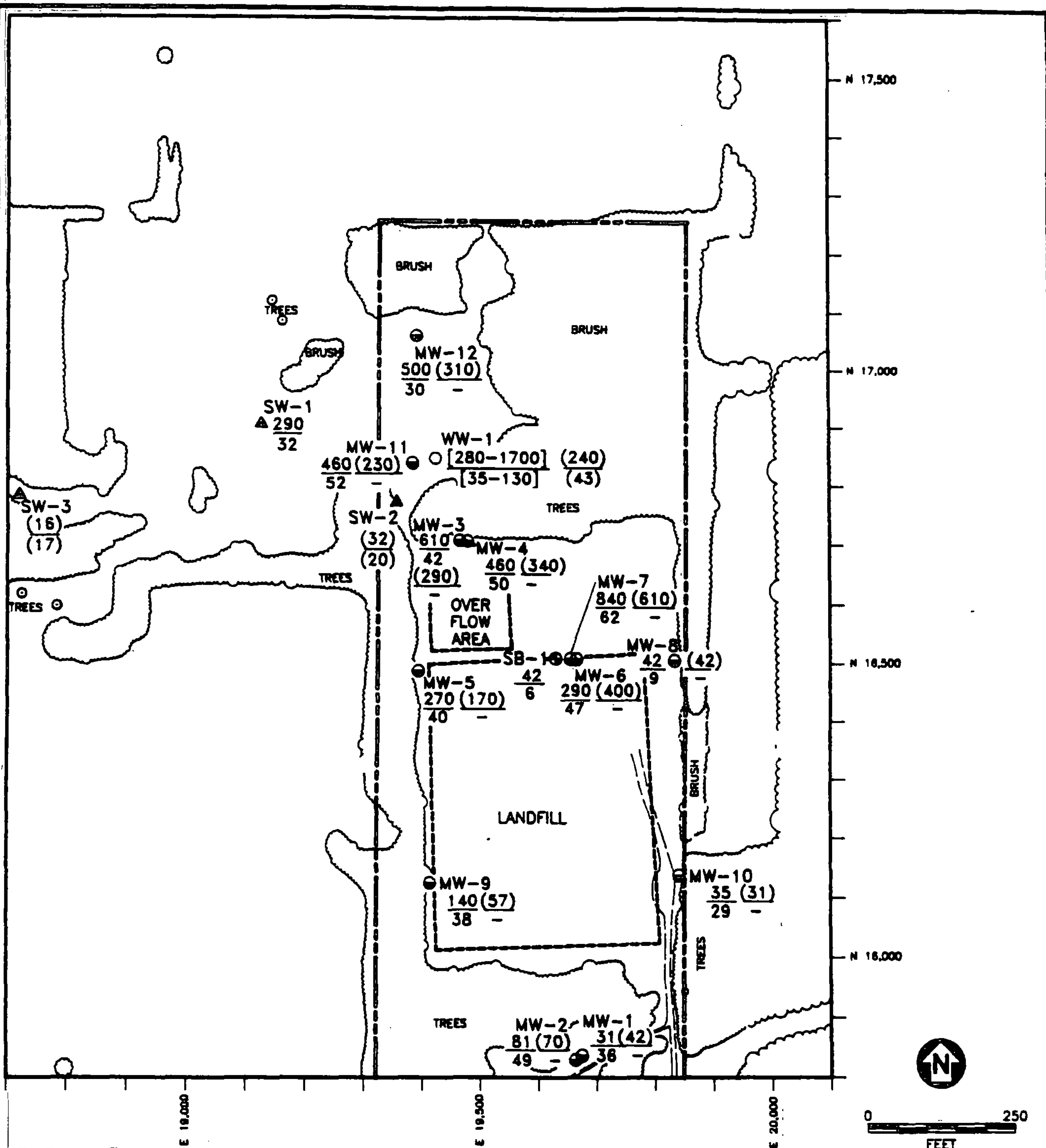
DRAFT BY	JEA 3/16/90	DRAFT CHK		PROJ. CHK	11-12-90	APPRV. BY	11-12-92	DRAWING NUMBER	446493-A50

EXPLANATION

- MONITORING WELL (MW)
- STRATIGRAPHIC BORING (SB)
- SHALLOW DUG WELL (WW)
- SURFACE WATER (SW) SAMPLING LOCATION
- 37 POTASSIUM CONCENTRATION (mg/L) DECEMBER 1989
- (14) POTASSIUM CONCENTRATION (mg/L) APRIL 1990
- PROPERTY LINE
- PERIMETER OF LANDFILL
- UNPAVED ROAD
- TREES OR BRUSH

FIGURE 6-28

CONCENTRATION OF
POTASSIUM
IN WATER
AMERT SITE INVESTIGATION
PREPARED FOR
WHIRLPOOL CORPORATION
CLYDE, OHIO



EXPLANATION

- MONITORING WELL (MW)
- STRATIGRAPHIC BORING (SB)
- SHALLOW DUG WELL (WW)
- SURFACE WATER (SW) SAMPLING LOCATION
- 140 SODIUM CONCENTRATION (mg/L) / 38 CHLORIDE CONCENTRATION (mg/L) DECEMBER 1989
- (32) SODIUM CONCENTRATION (mg/L) JUNE 1990 / (20) CHLORIDE CONCENTRATION (mg/L) APRIL 1990
- [35-130] RANGE OF CONCENTRATION FROM PREVIOUS ANALYSIS (mg/L)
- PROPERTY LINE
- PERIMETER OF LANDFILL
- UNPAVED ROAD
- TREES OR BRUSH

FIGURE 6-29

CONCENTRATION OF
SODIUM/CHLORIDE
IN WATER
AMERT SITE INVESTIGATION
PREPARED FOR
WHIRLPOOL CORPORATION
CLYDE, OHIO

DRAWING NUMBER 446493-A48

APPRV. BY: hms 11-12-90
PROJ. CHK: hms 11-12-90
DRAFT CHK: [illegible] 11/12/90
DRAFT BY: JEA 3/15/90

Do Not Scale This Drawing

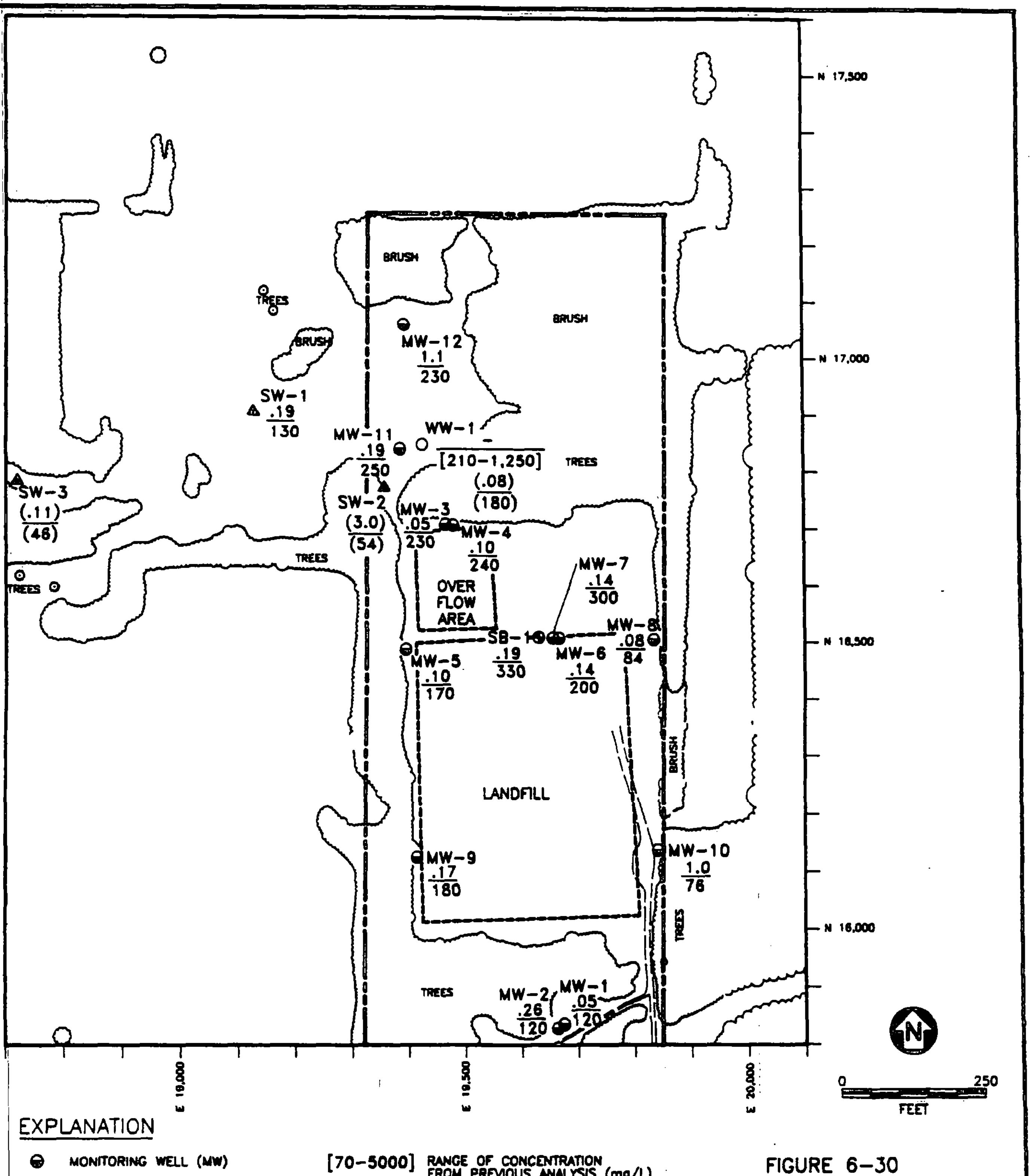


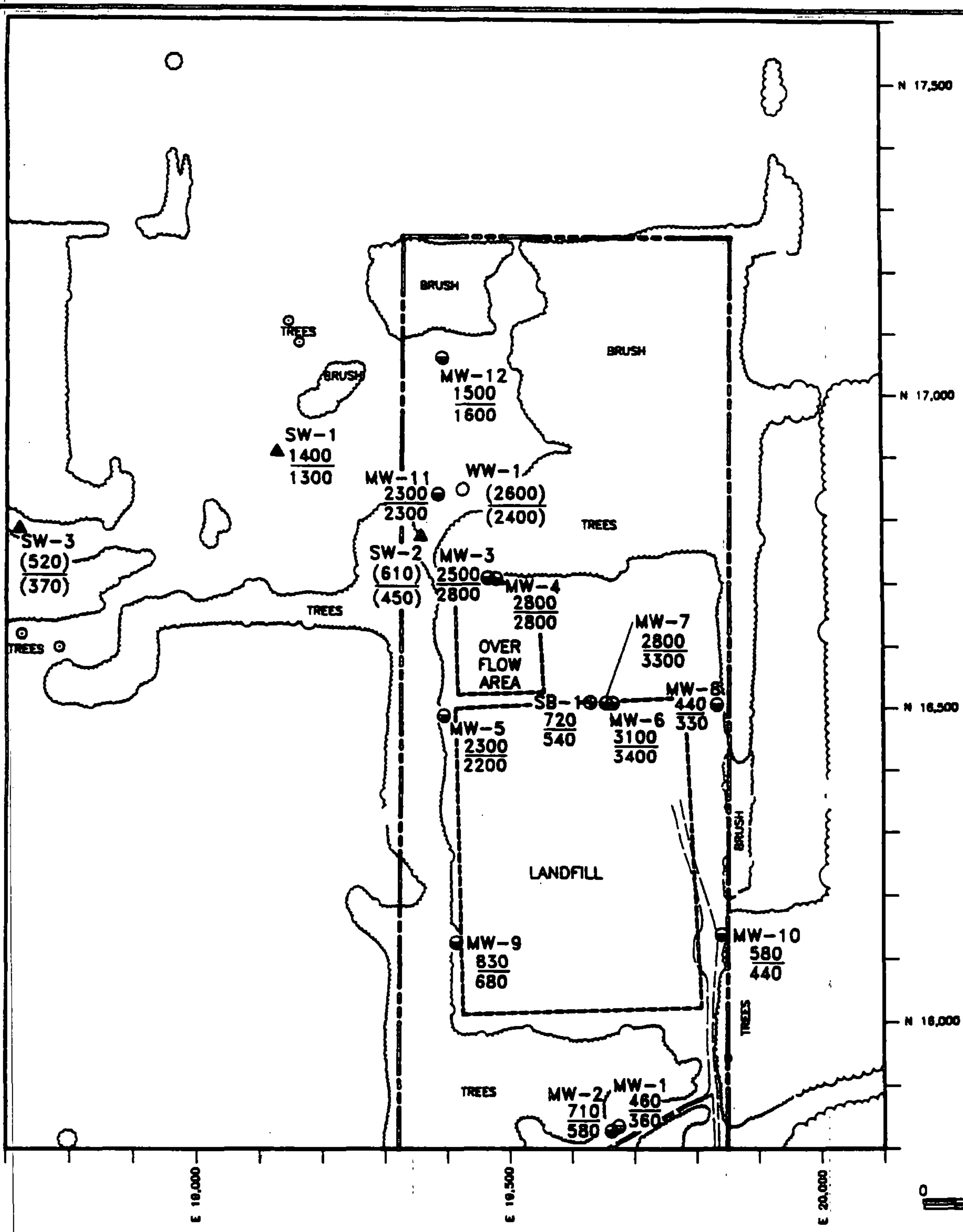
FIGURE 6-30

CONCENTRATION OF
NITRATE/SULFATE
IN WATER
AMERT SITE INVESTIGATION
PREPARED FOR
WHIRLPOOL CORPORATION
CLYDE, OHIO

DRAWING NUMBER 446493-A47

DRAFT BY JEA 3/15/90 | DRAFT CHK | PROJ. CHK | APPRV BY 11-12-90

Do Not Scale This Drawing



DRAWING NUMBER 446493-A51
APPRV. BY
PROJ. CHK
DRAFT CHK
DRAFT BY JEA 3/15/90

Do Not Scale This Drawing

EXPLANATION

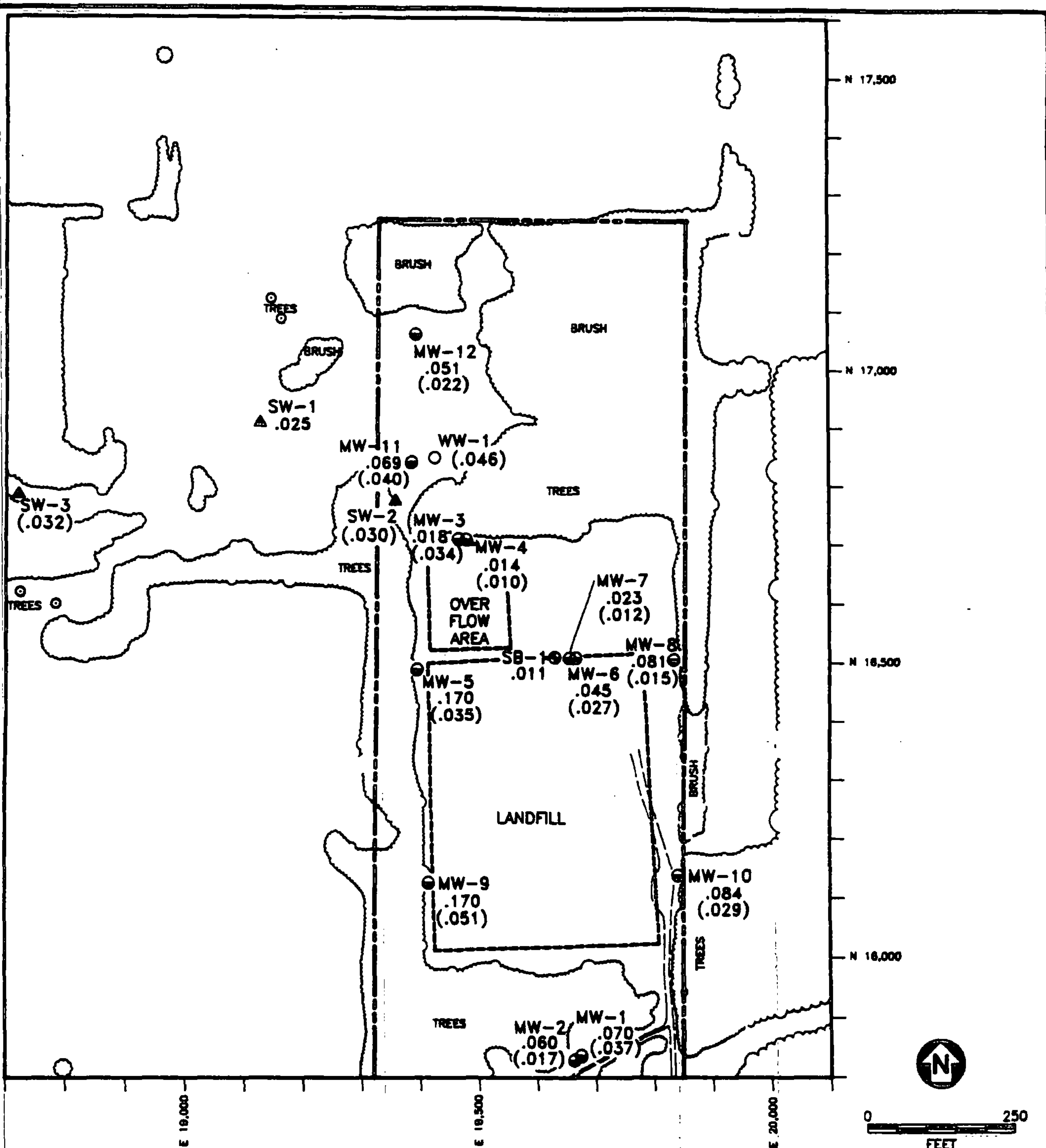
- MONITORING WELL (MW)
- STRATIGRAPHIC BORING (SB)
- SHALLOW DUG WELL (WW)
- SURFACE WATER (SW) SAMPLING LOCATION

440 CONDUCTIVITY (µmho\cm)
330 TOTAL DISSOLVED SOLIDS CONCENTRATION (mg/L) DECEMBER 1989

(520) CONDUCTIVITY (µmho\cm)
(370) TOTAL DISSOLVED SOLIDS CONCENTRATION (mg/L) APRIL 1990

PROPERTY LINE
PERIMETER OF LANDFILL
UNPAVED ROAD
TREES OR BRUSH

FIGURE 6-31
CONCENTRATION OF CONDUCTIVITY/ TOTAL DISOLVED SOLIDS IN WATER
AMERT SITE INVESTIGATION
PREPARED FOR
WHIRLPOOL CORPORATION
CLYDE, OHIO



EXPLANATION

- MONITORING WELL (MW)
- STRATIGRAPHIC BORING (SB)
- SHALLOW DUG WELL (WW)
- SURFACE WATER (SW) SAMPLING LOCATION
- .069 ZINC CONCENTRATION (mg/L) DECEMBER 1989
- (.032) ZINC CONCENTRATION (mg/L) APRIL 1990
- PROPERTY LINE
- PERIMETER OF LANDFILL
- UNPAVED ROAD
- TREES OR BRUSH

FIGURE 6-32
CONCENTRATION OF
ZINC
IN WATER
AMERT SITE INVESTIGATION
PREPARED FOR
WHIRLPOOL CORPORATION
CLYDE, OHIO

DRAFT BY	JEA 3/16/90	DRAFT CHK	RCP 11/12/90	PROJ. CHK	MB 11-12-90	APPRV. BY	MB 11-12-90	DRAWING NUMBER	446493-A57

Do Not Scale This Drawing

Table 6-1. Water Level Data

WELL NO.	TOTAL DEPTH (Ft. BGL)	TOP OF CASING ELEVATION (Ft. MSL)	SCREENED INTERVAL (Ft. BGL)	WATER LEVEL (Ft. TOC)				WATER ELEVATIONS (Ft. MSL)			
				11/29/89	12/3/89	12/5/89	4/24/90	11/29/89	12/3/89	12/5/89	4/24/90
MW-1	13.04	689.49	8.20-12.16	10.16	10.44	10.40	8.27	679.33	679.05	679.09	681.22
MW-2	20.86	689.73	16.00-19.96	10.17	10.63	10.56	8.07	679.56	679.10	679.17	681.66
MW-3	10.33	681.62	5.50-9.45	-	7.35	7.39	5.42	-	674.27	674.23	676.20
MW-4	15.21	681.56	10.37-14.33	-	7.48	7.26	5.60	-	674.08	674.30	675.96
MW-5	19.85	687.07	10.00-19.10	-	11.77	11.67	8.99	-	675.30	675.40	678.08
MW-6	14.15	687.75	9.31-13.27	11.21	12.36	12.18	9.20	676.54	675.39	675.57	678.55
MW-7	21.39	687.70	16.55-20.50	13.96	12.26	12.14	9.20	675.56	675.44	675.56	678.50
MW-8	19.38	686.05	9.54-18.50	-	10.52	10.40	7.07	-	675.53	675.65	678.98
MW-9	19.45	688.16	9.90-18.80	-	11.17	11.13	8.20	-	676.99	677.03	679.96
MW-10	19.40	690.30	9.75-18.75	-	11.70	12.97	9.78	-	678.60	677.33	680.52
MW-11	7.27	674.03	2.64-6.60	-	-	3.78	2.73	-	-	670.25	671.30
MW-12	4.00	669.20	1.75-3.75	-	-	4.04	3.03	-	-	665.16	666.17
SB-1	94.08	688.04	69.8-93.58	19.50	-	-	-	668.54	-	-	-

Notes:
MSL = Mean Sea Level
BGL = Below Ground Level
TOC = Top of Casing

Table 6-2. Results of Analysis of Composite Waste Sample

PARAMETER	UNITS	CONCENTRATION	PREPARATION
Arsenic	mg/kg	16	Total Digestion
Barium	mg/kg	1,500	
Boron	mg/kg	1,500	
Cadmium	mg/kg	2.7	
Chromium	mg/kg	110	
Cobalt	mg/kg	210	
Copper	mg/kg	42	
Iron	mg/kg	18,000	
Lead	mg/kg	160	
Manganese	mg/kg	620	
Nickel	mg/kg	470	
Phosphorus	mg/kg	270	
Sulfide	mg/kg	12	
Thallium	mg/kg	0.2	
Titanium	mg/kg	2,000	
Total Cyanide	mg/kg	0.32	
Total Organic Carbon	%	7	
Vanadium	mg/kg	5	
Zinc	mg/kg	1,200	
Antimony	mg/kg	<0.3	
Beryllium	mg/kg	<0.1	
Mercury	mg/kg	<0.02	
Selenium	mg/kg	<0.5	
Silver	mg/kg	<1.0	
Tin	mg/kg	<100	
Calcium	mg/L	16	7-Day Water Leach
Magnesium	mg/L	15	
Potassium	mg/L	25	
Sodium	mg/L	26	
Alkalinity	mg/L	140	
Sulfate	mg/L	2	
Chloride	mg/L	3	
Nitrate	mg/L	0.06	
Fluoride	mg/L	18	
Phosphorus	mg/L	1.8	
pH	mg/L	8	
Iron	mg/L	0.76	

Note:
None of the following were present above detection limits: Appendix IX Volatiles, Extractables, Herbicides, Pesticides, PCB's. Laboratory certificates in Appendix D.

Table 6-3. Results of Analysis of Soil Samples

LOCATION	MW-1	MW-4	MW-5	MW-7	MW-8	MW-9	MW-10	MW-11	MW-12	SS-1	SS-2	SS-3	SS-4	SS-5
DEPTH (Ft.)	2 - 4	1 - 3	1 - 2	2 - 3	1 - 4	2 - 4	2 - 4	1 - 2	1 - 2	0.5 - 1	0.5 - 1	0.5 - 1	0.5 - 1	0.5 - 1
DATE	Dec-89	Dec-89	Dec-89	Dec-89	Dec-89	Dec-89	Dec-89	Dec-89	Dec-89	Dec-89	Dec-89	Dec-89	Dec-89	Dec-89
ARSENIC	2.8	2.1	3.3	2.3	5.5	6	4.6	10	25	3.9	50	9.9	6.1	7.9
BARIUM	6.7	7.3	<3.0	12	8.7	31	14	22	100	17	52	47	25	42
BORON	<20	25	35	<20	24	<20	35	48	190	29	260	41	<20	<20
CADMIUM	2.2	<1.0	1.3	<1.0	1.7	2.8	<1.0	1.3	3.7	1.7	4.1	2.8	2.4	<1.0
CHROMIUM	4.7	8.7	6.6	4	7.3	6.5	6.1	7.7	4.6	5.8	6.7	12	11	6.8
COBALT	3.9	4	2.2	2.2	5.6	3.8	3	3.2	<2.0	3	2.1	4.9	3.8	8.7
COPPER	1.4	3.6	3.5	1.8	5.3	5.2	3	4.8	7.7	2.7	13	9.2	5.2	3
IRON	6900	5800	7100	2800	9900	9400	7800	18000	94000	8700	75000	22000	19000	14000
LEAD	1.6	1.6	3.6	2.3	3.1	12	2.6	5	2.8	4.7	5.1	9.4	4.5	3.2
MANGANESE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NICKEL	3.8	6.8	5.8	6.4	6.2	5.8	7.7	7.2	<3.0	6.2	11	6.3	3.7	6.5
PHOSPHORUS	290	310	200	160	970	240	400	67	110	90	77	250	280	220
SODIUM	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TITANIUM	140	150	140	120	190	140	140	130	70	130	80	90	190	120
VANADIUM	10	7.3	9.9	3.8	16	9.6	9.4	15	11	11	20	19	25	15
ZINC	9.4	18	27	17	19	38	14	18	48	22	38	59	25	25

LOCATION	SS-6	SS-7	SS-8	SS-9	SS-10	SS-11	SS-12	SS-13	SS-14	SS-15	SS-16	SS-17	SS-18
DEPTH (Ft.)	0.5 - 1	0.5 - 1	0.5 - 1	0.5 - 1	0.5 - 1	1 - 1.5	1.5 - 2	0.5 - 1	1 - 1.5	1.5 - 2	0.5 - 1	0.5 - 1	0.5-1.0
DATE	Apr-90	Apr-90	Apr-90	Apr-90	Apr-90	Apr-90	Apr-90	Apr-90	Apr-90	Apr-90	Apr-90	Apr-90	Aug-90
ARSENIC	3.8	7.4	23	41	9.1	9.1	9.2	9.5	16	20	43	9.5	
BARIUM	12	32	48	34	85	55	55	28	29	36	75	590	
BORON	5.3	27	140	140	13	12	9.6	20	15	36	8.5	12	
BORON*	0.4	16	77	60	5.6	6.8	5.5	10	8.7	11	NA	4.7	11
CADMIUM	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
CHROMIUM	4.8	10	5.5	7.5	16	18	16	11	8.5	14	7.5	5.5	
COBALT	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
COPPER	1.8	6	1.3	<0.1	9.5	15	15	1.3	4.6	12	0.75	<0.1	
IRON	8100	14000	50000	125000	29000	23000	24000	16000	17000	23000	63000	16000	
LEAD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
MANGANESE	90	90	1100	480	950	450	500	200	490	210	1500	6000	
NICKEL	5.5	7.5	8.5	5.5	23	27	28	7.5	12	18	12	9.5	
PHOSPHORUS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
SODIUM	48	230	300	220	84	92	85	140	130	180	44	75	
SODIUM*	38	180	490	280	90	83	120	120	170	150	NA	95	170
TITANIUM	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
VANADIUM	6	9	<0.4	8.5	20	15	14	15	13	9.5	<0.4	<0.4	
ZINC	14	35	21	50	50	55	50	26	27	55	40	32	

* Sampling locations were resampled in August 1990 for Boron and Sodium analyses
All results in mg/kg
NA - Not Analyzed
Note: "MW" Samples are SOILS from monitoring well borings
Analytical methods listed in Table 5-4

TABLE 6-4. Results of Analysis of Water Samples, Minor Constituents

WELL NO. DATE	MW-1 Dec-89	MW-1 Apr-90	MW-2 Dec-89	MW-2 Apr-90	MW-3 Dec-89	MW-3 Apr-90	MW-4 Dec-89	MW-4 Apr-90
ARSENIC	0.013	0.007	0.005	<0.002	0.004	<0.002	0.006	<0.002
BARIUM	0.16	0.065	0.18	0.081	0.15	0.080	0.072	0.062
BORON	14	14	29	25	290	140	220	150
CADMIUM	<0.010	NA	<0.010	NA	<0.010	NA	<0.010	NA
CHROMIUM	<0.010	NA	<0.010	NA	<0.010	NA	<0.010	NA
COBALT	<0.020	NA	<0.020	NA	<0.020	NA	<0.020	NA
COPPER	<0.010	<0.0020	<0.010	<0.0020	<0.010	0.0021	<0.010	<0.0020
CYANIDE	NA	<0.010	NA	<0.010	NA	<0.010	NA	<0.010
LEAD	<0.001	NA	<0.001	NA	<0.001	NA	<0.001	NA
NICKEL	<0.030	<0.0080	<0.030	<0.0080	0.036	0.024	0.047	0.026
THALLIUM	NA	<0.001	NA	<0.001	NA	<0.001	NA	<0.001
TITANIUM	<0.03	NA	<0.03	NA	<0.03	NA	<0.03	NA
VANADIUM	<0.020	<0.0080	<0.020	<0.0080	<0.020	<0.0080	<0.020	<0.0080
ZINC	0.070	0.037	0.060	0.017	0.018	0.034	0.014	0.010
TPH	NA	<1	NA	<1	NA	<1	NA	<1

WELL NO. DATE	MW-5 Dec-89	MW-5 Apr-90	MW-6 Dec-89	MW-6 Apr-90	MW-7 Dec-89	MW-7 Apr-90	MW-8 Dec-89	MW-8 Apr-90
ARSENIC	0.010	0.003	0.010	<0.002	0.006	<0.002	<0.002	0.003
BARIUM	0.39	0.072	0.12	0.064	0.12	0.087	0.15	0.034
BORON	160	76	150	180	390	260	19	13
CADMIUM	<0.010	NA	<0.010	NA	<0.010	NA	<0.010	NA
CHROMIUM	<0.010	NA	<0.010	NA	<0.010	NA	<0.010	NA
COBALT	<0.020	NA	<0.020	NA	<0.020	NA	<0.020	NA
COPPER	0.012	0.0028	<0.010	<0.0020	<0.010	<0.0020	<0.010	<0.0020
CYANIDE	NA	<0.010	NA	<0.010	NA	<0.010	NA	<0.010
LEAD	<0.001	NA	<0.001	NA	<0.001	NA	<0.001	NA
NICKEL	<0.030	<0.0080	0.052	0.032	0.058	0.041	<0.030	<0.0080
THALLIUM	NA	<0.001	NA	<0.001	NA	<0.001	NA	<0.001
TITANIUM	<0.03	NA	<0.03	NA	<0.03	NA	<0.03	NA
VANADIUM	<0.020	<0.0080	<0.020	<0.0080	0.023	<0.0080	<0.020	<0.0080
ZINC	0.17	0.035	0.045	0.027	0.023	0.012	0.081	0.015
TPH	NA	<1	NA	<1	NA	<1	NA	<1

NA - Not Analyzed
All results in mg/L
TPH - Total Petroleum Hydrocarbons

TABLE 6-4. Results of Analysis of Water Samples, Minor Constituents (Continued)

WELL NO. DATE	MW-9 Dec-89	MW-9 Apr-90	MW-10 Dec-89	MW-10 Apr-90	MW-11 Dec-89	MW-11 Apr-90	MW-12 Dec-89	MW-12 Apr-90
ARSENIC	0.003	<0.002	0.003	<0.002	0.004	<0.002	<0.002	<0.002
BARIUM	0.39	0.07	0.16	0.029	0.18	0.050	0.11	0.016
BORON	37	25	8.3	7.3	250	100	190	120
CADMIUM	<0.010	NA	<0.010	NA	<0.010	NA	<0.010	NA
CHROMIUM	<0.010	NA	<0.010	NA	<0.010	NA	<0.010	NA
COBALT	<0.020	NA	<0.020	NA	<0.020	NA	<0.020	NA
COPPER	<0.010	0.0043	<0.010	0.0045	<0.010	0.0073	0.012	0.0042
CYANIDE	NA	0.02	NA	0.02	NA	<0.010	NA	<0.010
LEAD	<0.001	NA	<0.001	NA	<0.001	NA	<0.001	NA
NICKEL	<0.030	<0.0080	<0.030	<0.0080	0.046	0.014	<0.030	0.029
THALLIUM	NA	<0.001	NA	<0.001	NA	<0.001	NA	<0.001
TITANIUM	<0.03	NA	<0.03	NA	<0.03	NA	<0.03	NA
VANADIUM	<0.020	<0.0080	<0.020	<0.0080	<0.020	<0.0080	<0.020	<0.0080
ZINC	0.170	0.051	0.084	0.029	0.069	0.040	0.051	0.022
TPH	NA	<1	NA	<1	NA	<1	NA	<1

WELL NO. DATE	SB-1 Dec-89	Shrader Well Apr-90	WW-1 Dug Well Apr-90	SW-1 Dec-89	SW-2 Apr-90	SW-3 Apr-90
ARSENIC	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
BARIUM	0.067	0.007	0.057	0.096	0.023	0.019
BORON	1.9	0.23	120	83	16	4.4
CADMIUM	<0.010	<0.0016	<0.0016	<0.010	<0.0016	<0.0016
CHROMIUM	<0.010	NA	NA	<0.010	NA	NA
COBALT	<0.020	<0.0032	<0.0032	<0.020	<0.0032	<0.0032
COPPER	0.011	<0.0020	<0.0020	<0.010	<0.0020	<0.0020
CYANIDE	NA	NA	<0.010	NA	<0.010	<0.010
LEAD	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
NICKEL	<0.030	<0.0080	0.020	<0.030	<0.0080	<0.0080
THALLIUM	NA	NA	NA	NA	NA	NA
TITANIUM	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
VANADIUM	<0.020	<0.0080	<0.0080	<0.020	<0.0080	<0.0080
ZINC	0.011	0.640	0.046	0.025	0.030	0.032
TPH	NA	NA	<2	NA	<1	<1

NA - Not Analyzed
All results in mg/L
TPH - Total Petroleum Hydrocarbons

TABLE 6-5. Results of Analysis of Water Samples, General Water-Quality Parameters

SAMPLE LOCATION DATE	MW-1 Dec-89	MW-2 Dec-89	MW-3 Dec-89	MW-4 Dec-89	MW-5 Dec-89	MW-6 Dec-89
CALCIUM	57	94	52	56	49	80
MAGNESIUM	10	20	230	160	270	270
SODIUM (1)	31/42	81/70	610/290	460/340	270/170	290/400
POTASSIUM	1.2	1.3	28.0	25.0	37.0	34.0
ALKALINITY	150	310	1,900	1,800	1,600	2,300
SULFATE	120	120	230	240	170	200
CHLORIDE	36	49	42	50	40	47
SP. CONDUCTIVITY	460	710	2,500	2,800	2,300	3,100
TDS	360	580	2,800	2,800	2,200	3,400
pH	6.8	7.2	7.7	7.6	7.6	7.6
FLUORIDE	0.28	0.69	17	11	19	25
NITRATE	0.05	0.26	0.05	0.10	0.10	0.14
IRON	3.9	1.2	0.18	0.15	0.14	0.16
MANGANESE (2)	0.18	0.25	0.21	0.30	0.32	1.8
TOTAL PHOSPHORUS	<0.05	<0.05	<0.05	<0.05	<0.05	0.07

SAMPLE LOCATION DATE	MW-7 Dec-89	MW-8 Dec-89	MW-9 Dec-89	MW-10 Dec-89	MW-11 Dec-89	MW-12 Dec-89
CALCIUM	56	71	74	88	59	59
MAGNESIUM	150	9.1	46	14	190	26
SODIUM (1)	840/610	42/42	140/57	35/31	460/230	500/310
POTASSIUM	20.0	1.2	9.8	1.3	19.0	0.6
ALKALINITY	1,900	240	420	260	1,500	860
SULFATE	300	84	180	76	250	230
CHLORIDE	62	9	38	29	52	30
SP. CONDUCTIVITY	2,800	440	830	580	2,300	1,500
TDS	3,300	330	680	440	2,300	1,600
pH	7.7	7.7	7.5	7.6	6.8	7.9
FLUORIDE	18	0.17	1.8	0.24	8.9	1.7
NITRATE	0.14	0.08	0.17	1.0	0.19	1.10
IRON	0.32	0.16	0.20	0.12	0.14	0.23
MANGANESE (2)	0.16	0.24	0.41	0.21	0.04	0.05
TOTAL PHOSPHORUS	<0.05	<0.05	<0.05	<0.05	<0.05	0.08

(1) Second sodium analysis in April 1990.
(2) Manganese analyzed in April 1990.
All results in mg/L except Sp. Conductivity (umho/cm) and pH (std. units).

TABLE 6-5. Results of Analysis of Water Samples, General Water-Quality Parameters (Continued)

SAMPLE LOCATION	SHRADER WELL	WW-1 DUG WELL	SB-1	SW-1	SW-2	SW-3
DATE	Apr-90	Apr-90	Dec-89	Dec-89	Apr-90	Apr-90
CALCIUM	330	55	91	63	47	67
MAGNESIUM	72	120	27	78	20	9.2
SODIUM	14	240	42	290	32	16
POTASSIUM	2.3	14	5.0	3.2	3.5	0.65
ALKALINITY	220	1500	180	840	270	240
SULFATE	1,200	180	330	130	54	46
CHLORIDE	14	43	6	32	20	17
SP. CONDUCTIVITY	2,100	2,600	720	1,400	610	520
TDS	2,100	2,400	540	1,300	450	370
pH	7.1	7.4	7.9	8.2	7.1	7.3
FLUORIDE	1.0	12	1.7	2.3	1.4	0.33
NITRATE	NA	0.08	0.19	0.19	3.0	0.11
IRON	1.7	2.2	0.053	0.13	0.0036	0.23
MANGANESE	0.14	0.094	NA	NA	0.0018	0.12
TOTAL PHOSPHORUS	NA	1.3	0.06	<0.05	<0.05	0.33

All results in mg/L except Sp. Conductivity (umho/cm) and pH (std. units).
Well SB-1 and Shrader Well are completed in bedrock.
NA - Not Analyzed

Table 6-6. Results of Slug Tests

WELL	K (CM/SEC)	K (FT/DAY)
MW-4	8.0E-04	2.3
MW-5	6.8E-03	19.3
MW-8	3.6E-03	10.2
MW-9	5.0E-03	14.2
MW-10	9.0E-03	25.5

Table 6-7. Results of Geotechnical Analyses of Landfill Cap

BORING	SAMPLE NO.	DEPTH (FT.)	WATER CONTENT (%)	LL	PL	PI	USCS
WB-1	2	1	14.4	NP	NP	NP	SW
WB-1	1	2	20.7	27.9	18	9.9	CL
WB-2	7	1	12.5	NP	NP	NP	SW
WB-2	6	1.5-2	19.7	35.9	22.5	13.4	CL
WB-3	11	1.0-1.5	10.8	NP	NP	NP	SW
WB-3	12	1.5-2.0	20.8	33.2	21.6	11.6	CL

Notes:
LL - Liquid Limit
PL - Plastic Limit
PI - Plasticity Index
USCS - Unified Soil Classification System Category
NP - Non-Plastic

TABLE 6-8

SUMMARY OF GEOCHEMICAL OBSERVATIONS

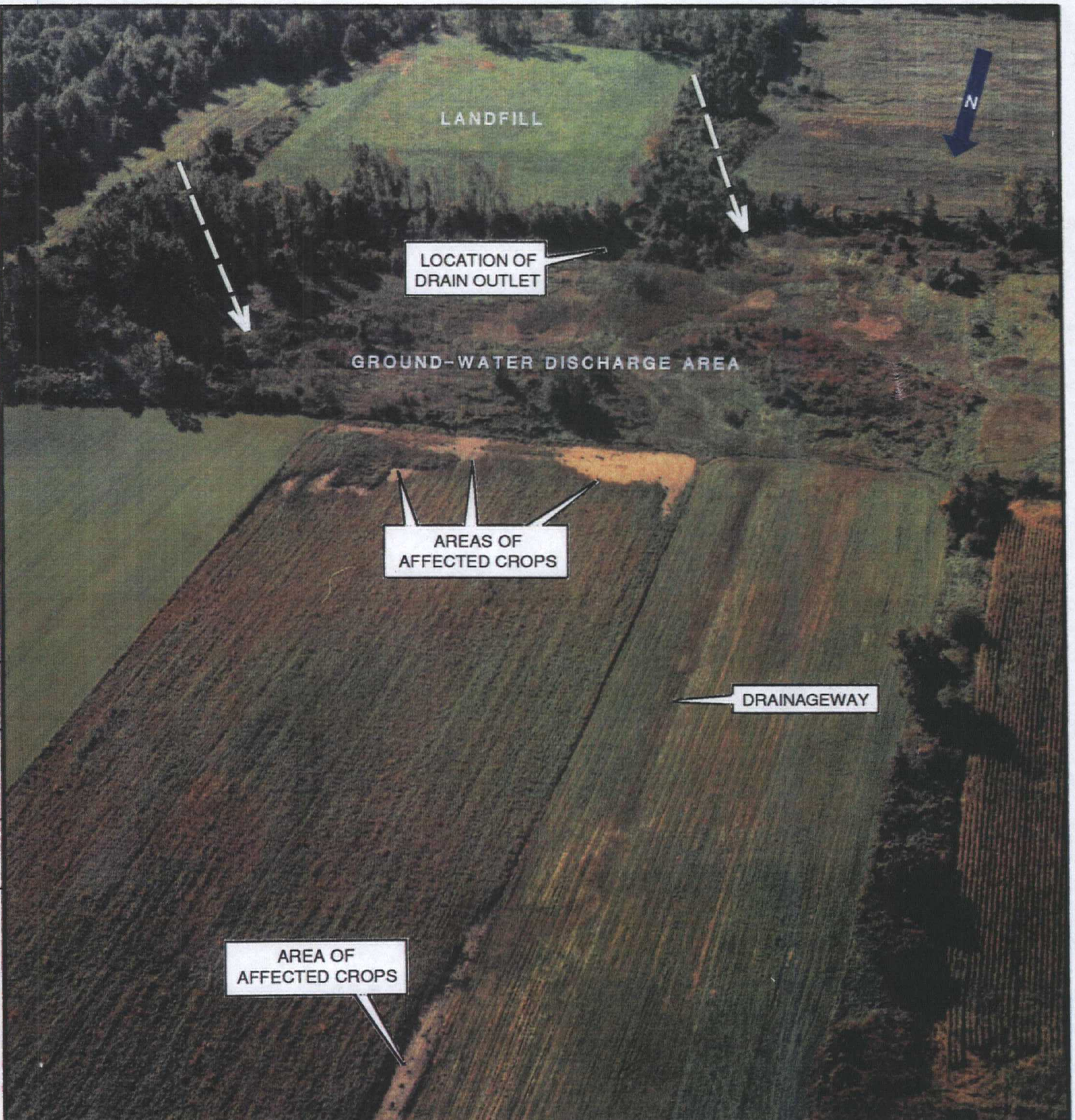
PARAMETER	CONCENTRATION ELEVATED IN SOILS TO NORTH?	CONCENTRATION ELEVATED IN CLAY RELATIVE TO SAND?	CONCENTRATION ELEVATED IN CROP FIELD?	CONCENTRATION ELEVATED IN GROUND WATER TO NORTH?	MIGRATING IN GROUND WATER?	COMMENTS
Arsenic	Y	Y	N	N	?	Very local migration in water. Not in surface water. Naturally higher in clay. May be partly of agricultural origin to north.
Barium	Y	Y	N	N	N	Water - not migrating. Soil - elevated concentrations to north. May be of agricultural or natural origin.
Boron	Y	N	Y	Y	Y	Present in soil and ground water at elvated concentrations to north of landfill.
Cadmium	N	N	N	N	N	Not migrating.
Chromium	Y	Y	N	N	N	High in corn, pasture only. Chromium could be related to clayey soils or agricultural practices. Elevated only north of property line.
Cobalt	Y	?	N	N	N	High in corn, pasture. See chromium.
Copper	Y	Y	N	N	N	May be agricultural. Appears to be higher in clayey soils.
Iron	Y		Y	N	N	High in background wells. May be higher in clayey soils.
Lead	Slight	?	N	N	N	May be agricultural or naturally higher in clay. Not found in water but slightly elevated in soil/sediment to north and at MW-9.
Nickel	N	Y	N	Slight	Slight	Very slight migration in water only. Higher in clayey soils. Appears to be concentrating in natural ground-water discharge areas.
Phosphorus	N	Y	N	Slight	Slight	Detected in three wells very slightly above detection limits. Higher agricultural fields. Low in discharge area. May be partly of agricultural origin?

TABLE 6-8

SUMMARY OF GEOCHEMICAL OBSERVATIONS

PARAMETER	CONCENTRATION ELEVATED IN SOILS TO NORTH?	CONCENTRATION ELEVATED IN CLAY RELATIVE TO SAND	CONCENTRATION ELEVATED IN CROP FIELD?	CONCENTRATION ELEVATED IN GROUND WATER TO NORTH?	MIGRATING IN GROUND WATER?	COMMENTS
Titanium	N	N	N	N	N	Not migrating.
Vanadium	Y	Y	N	N	N	May be naturally high in clays.
Zinc	Y	Y	N	N	N	Naturally highest in clayey soils to north.
Calcium	-	-	N	N	N	Not migrating.
Magnesium	-	-	Y	Y	Y	Migrating.
Sodium	-	-	Y	Y	Y	Migrating. May affect soil properties.
Potassium	-	-	Y	Slight	Y	Migrating.
Alkalinity	-	-	Y	Y	Y	Boron content is reflected in alkalinity levels.
Sulfate	-	-	Y	Very Slightly	Y	Migrating.
Chloride	-	-	N	N	N	Not migrating.
Nitrate	-	-	Y	N	N	Highest near field. Probably agricultural (fertilizer). High in MW-10.
Fluoride	-	-	Y	Y	Y	Migrating.
TDS	-	-	Y	Y	Y	General salinity indicator.
Conductivity	-	-	Y	Y	Y	Physical parameter reflecting salinity.

IT



Aerial Photo Source: Miller Photography.

EXPLANATION

DIRECTION OF GROUND-WATER FLOW

FIGURE 6-1b

AERIAL PHOTO SHOWING LANDFILL SITE AND SURROUNDING AREA

PREPARED FOR

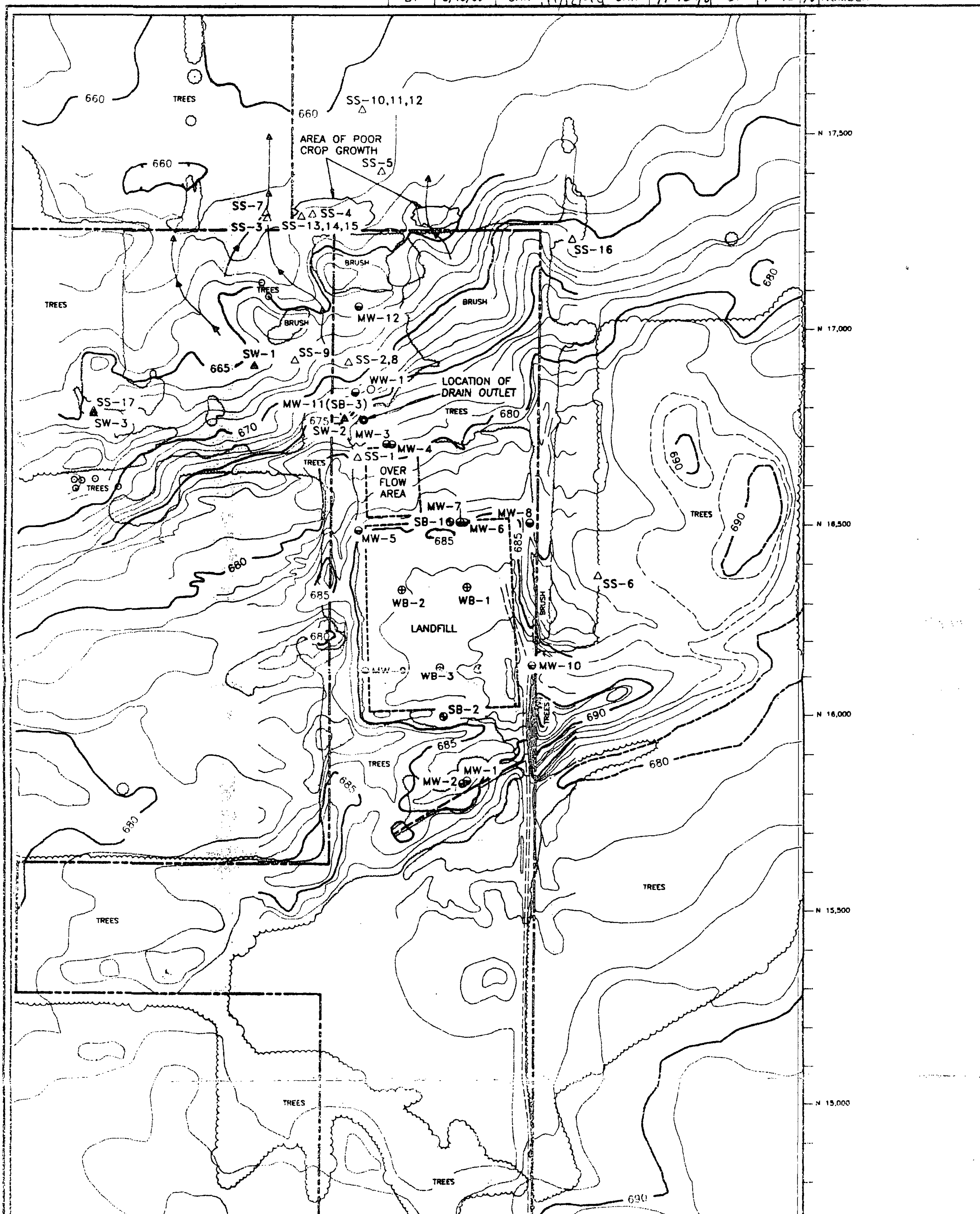
WHIRLPOOL CORPORATION
CLYDE, OHIO

DRAFT BY	RPS 10/25/90	DRAFT CHK	CMR 11-12-90	PROJ. CHK	MB 11-12-90	APPRV. BY	MB 11-12-90	DRAWING NUMBER	446493-A97

Do Not Scale This Drawing

Do Not Scale This Drawing

DRAFT BY	JEA 3/16/90	DRAFT CHK	11/12/90	PROJ. CHK	11-12-90	APPRV. BY	11-12-90	DRAWING NUMBER	446493-B3



EXPLANATION

- MONITORING WELL (MW)
- WASTE BORING (WB)
- STRATIGRAPHIC BORING (SB)
- SURFACE SEDIMENT (SS) SAMPLING LOCATION
- SURFACE WATER (SW) SAMPLING LOCATION
- SHALLOW DUG WELL (WW)
- SELECTED PROPERTY LINES (APPROXIMATE)
- PERIMETER OF LANDFILL
- UNPAVED ROAD
- TREES OR BRUSH
- SURFACE-WATER DRAINAGE PATH IN GROUND-WATER DISCHARGE AREA

0 250
FEET

FIGURE 6-1a

SITE TOPOGRAPHIC MAP
AMERT SITE INVESTIGATION

PREPARED FOR

WHIRLPOOL CORPORATION
CLYDE, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

DRAWING NUMBER 446493-B1

DRAFT BY	DRAFT CHK	PROJ. CHK	APPRV. BY
JEA 4/2/90	[illegible] 11/12/90	MB 11-12-90	MB 11-12-90

Do Not Scale This Drawing

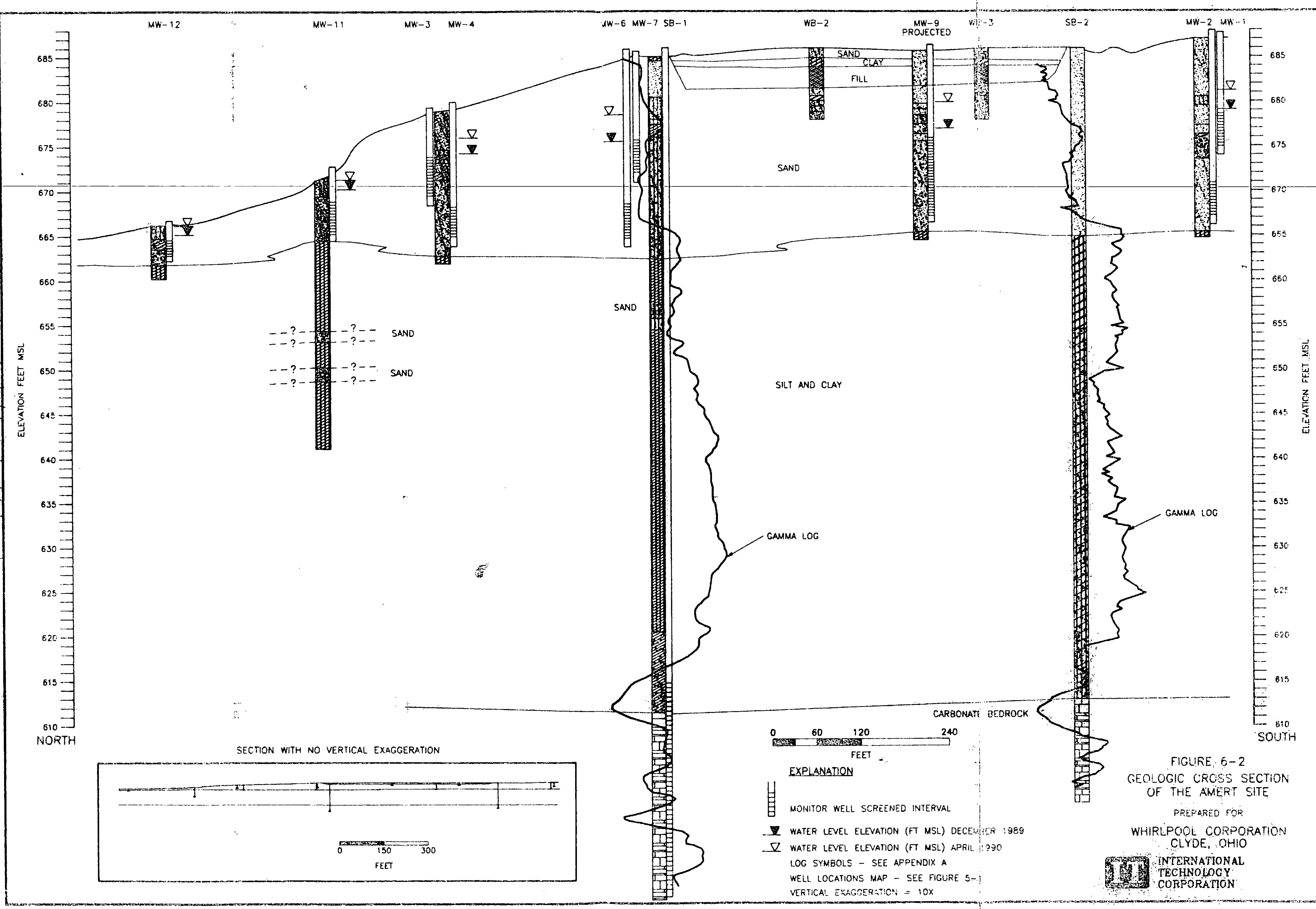


FIGURE 6-2
GEOLOGIC CROSS SECTION OF THE AMERT SITE

7.0 CONCLUSIONS AND RECOMMENDATIONS

7.1 EFFECTS OF THE LANDFILL ON SOIL AND WATER

Groundwater that has contacted the waste sludges deposited in the landfill migrates northward for a relatively short distance in the shallow sand, then discharges since the sand body terminates approximately 700 feet north of the northern edge of the landfill. The ground water discharges between the landfill and the pinchout of the sand.

Part of the shallow ground-water discharges as a surface flow, and some waste constituents can move overland along a surface-water drainageway in a pasture. Boron-tolerant plants appear to have replaced annual grasses in a narrow (3-6 ft wide) strip along this drainageway. Apparently, a significant part of the ground water emerges as evaporation from the soil surface or as evapotranspiration through the leaves of plants, and waste constituents can accumulate in the soil in the discharge area. The dimensions of the ground-water discharge area on the slope downgradient from the landfill are about 700 feet by 400 feet.

Water samples from underlying bedrock aquifer indicate that it has not been affected by waste constituents. The intervening glacial till appears to provide a good barrier to vertical migration of shallow ground-waters.

The material which has leached from waste in the landfill consists principally of boron, as well as several naturally-occurring major ionic species found in ground water everywhere. These major ions include sodium, magnesium, potassium, sulfate, and fluoride.

7.2 EFFECTS OF THE LANDFILL ON HUMANS AND ANIMALS

The major ions in affected ground-water at the site occur in concentrations higher than those which are desirable for drinking water. The Primary Drinking Water Standard for fluoride is 1.4 to 2.4 milligrams per liter (mg/L), depending on water temperature. The maximum concentration of sulfate recommended under Interim Secondary Drinking Water Standards is 200 mg/L. This means that water containing concentrations above this level of sulfate may be aesthetically objectionable to a number of persons but would not be hazardous to health. It should be noted that native ground water in the bedrock contains, in places, concentrations of natural sulfate in excess of those found in the shallow sand beneath the landfill.

There are no drinking water standards for sodium and potassium. Also, there is no drinking water standard for boron. The only known potential human effect gastrointestinal disturbance in the event of acute oral overexposure to high levels of boron in water (Sittig, 1985).

The waste constituents in the surface waters do not appear to be capable of causing harm to humans. High doses of concentrated boron are known to be potentially harmful, but there does not appear to be any reasonable pathway for this type of exposure. The current ingestion reference dose (risk assessment criterion) for boron and boron compounds is 0.09 mg/kg-day. If water contained 100 mg/L, which is higher than the highest concentration of boron in surface water measured during this study, a 150-lb person would have to drink more than 16 gallons per day to reach this dose.

Acceptable levels of boron in livestock diets may range up to 100 mg/L (U.S. Dept. Interior 1990). However, prolonged exposure of animals to even these levels of boron does not appear to be likely, since the area is not used for livestock grazing and surface waters are not present in any significant quantity except during wet periods, when the boron would be most dilute.

7.3 EFFECTS ON PLANTS

Many plants are sensitive to relatively low levels of boron in water. The principal environmental effect of the landfill at the Amert site is on plants. Boron appears to be causing distress of crops grown in two relatively small areas (about one-half acre total) along the southern edge of a field located to the north of the landfill.

A third area of crops is affected in a small area where a drainageway enters the west side of this field, several hundred feet to the north (Figure 6-1b). As mentioned above, boron-tolerant plants have replaced annual grasses along the drainageway in a strip 3-6 feet wide.

7.4 RECOMMENDATIONS

The best solution to the crop growth problems appears to be to prevent contact between boron-sensitive plants and the waters containing leached boron.

One way to prevent this contact would be to excavate and replace the soil along the southern border of the field. The thin sand layer underlying this area could be removed and replaced with less permeable clayey materials. This could retard movement of ground waters containing boron into this area. This method would not be effective in the small area to the north, at the western edge of the field, since this area is affected by surface waters rather than ground water. Also, it is uncertain if this remedy to the southern part of the field would be a permanent solution, since the replaced soil could not be made totally impermeable and some future migration of ground water into the area could occur.

Another alternative would be to cease production of boron-sensitive crops in the affected area along the southern border and at the western edge of the cropped field, which is a total area of about one-half acre. It may be possible to replace the boron-sensitive with more boron-tolerant species such as alfalfa, clover, or sugar beets.

A third alternative would be to allow the affected land to revert to a "natural" state, as has occurred on the land just south of the affected field, and allow boron-tolerant native species to colonize the area. Much of the area of greatest ground-water discharge to the south supports lush plant growth. Whirlpool could purchase the land or replace the income from lost agricultural production.

Removal of the materials from the site does not appear to be warranted, and would not immediately prevent ground-water containing boron from contacting the agricultural land. Although a variety of corrective actions is available, these do not appear to be cost-effective when weighed against the relatively small potential losses of agricultural production. Removal, transport, and redeposition of these materials elsewhere would entail risks which do not appear to be warranted, considering the non-hazardous nature of the affected waters.

8.0 REFERENCES

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APPENDIX
A

APPENDIX A

BORING LOGS AND COMPLETION DIAGRAMS

INTERNATIONAL TECHNOLOGY CORPORATION

Monitor Well Installation

Well No.: MW1

Client: WHIRLPOOL Job No.: 446493 Date Drilled: 11/29/89 Sheet 1 of 1

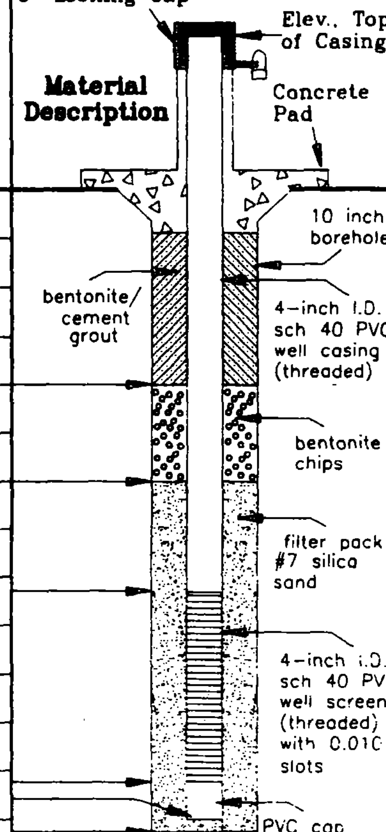
Site: AMERT, CLYDE OH. Elevation: Pad N/A Top of PVC Casing 689.49'

Total Depth: 13.1 FEET Casing Size & Type: 4" SCH. 40 PVC Screen Size: 0.010 INCH

Comments: 8 INCH AND 10 INCH HOLLOW STEM AUGER
2-FOOT SPLIT SPOON AND 5 FOOT CONTINUOUS SAMPLER

Depth in Feet	Stratigraphy	Symbol	Stratigraphy	Sample Description	Material Setting
				SAND, yellowish brown, medium, sand, well graded, roots, moist	
				SAND, yelloish brown, medium sand, well graded, moist	4
5				SAND, medium to fine sand, well graded, wet	6
				SILTY SAND, yellowish brown, fine to medium sand with silt (20-40%) moist to wet	
				SAND, pale brown, medium sand, well graded, wet to saturated at 8.5	8.2
10				SAND, gray, fine to medium sand, well graded, saturated	
				GRAVELLY SAND, gray, medium to fine sand with gravel 1/8" to 1/4" diameter, well graded, saturated	12.1 13.0 13.1
				TOTAL DEPTH = 13.1 FEET	
15					
20					

Completion Data



DRAWN BY	WAL	1/24/90	CHECKED BY	MB	11/12/90	APPROVED BY	VMB	11/12/90	DRAWING NUMBER	446493-A21

Monitor Well Installation

INTERNATIONAL TECHNOLOGY CORPORATION

Well No.: MW2

Client: WHIRLPOOL   Job No.: 446493   Date Drilled: 11/28/89   Sheet 1 of 1

Site: AMERT, CLYDE OH.   Elevation: Pad N/A   Top of PVC Casing 689.73'

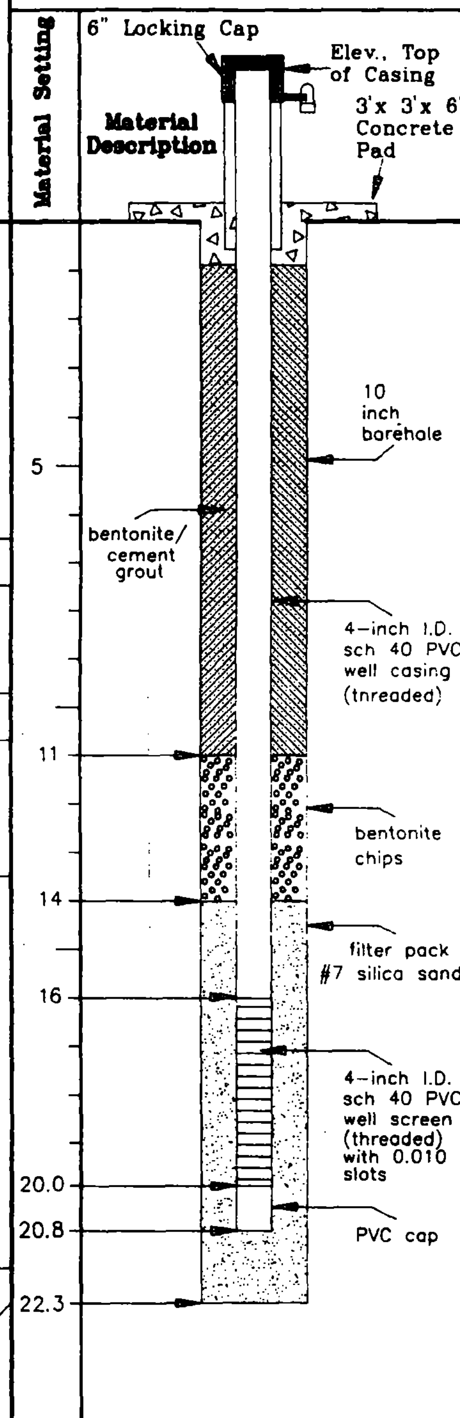
Total Depth: 22.3 FEET   Casing Size & Type: 4" SCH 40 PVC   Screen Size: 0.010 INCH

Comments: 8 INCH AND 10 INCH HOLLOW STEM AUGER
5-FEET SPLIT-SPOON CONTINUOUS SAMPLER

Depth in Feet	PID (ppm)	Symbol	Stratigraphy	Sample Description
	0.0	SW		SAND, yellowish brown, medium sand, well graded, roots, moist
	0.0	SW		SAND, yellowish brown, medium sand, well graded, moist
5	0.0			SAND, medium-fine sand, well graded, wet
		SW		SILTY SAND, yellowish brown, fine-medium sand with silt, (20-40%), moist-wet
	0.0	SW		SAND, pale brown, medium sand, well graded, wet- saturated at 8.5 feet
10	0.0	SW		SAND, gray, fine-medium sand, well graded,saturated
	0.0	SW		GRAVELLY SAND, gray, medium-fine sand with gravel 1/8"- 1/4", well graded, saturated
	0.0	SW		SAND, brownish gray, medium sand, well graded ,saturated
15		SW		SAND, brownish gray, medium sand, moderate-well graded, saturated
20		SW		SAND, brownish gray, medium sand, moderate-well graded, saturated SAND, brownish gray, medium sand, well graded, saturated-wet
		ML		CLAYEY SILT, brownish gray, silt with clay (20-30%) very firm with scattered rock fragments up to 1/4", moist

TOTAL DEPTH = 22.3 FEET

Completion Data



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INTERNATIONAL TECHNOLOGY CORPORATION

Monitor Well Installation

Well No.: MW3

Client: WHIRLPOOL Job No.: 446493 Date Drilled: 12/1/89 Sheet 1 of 1

Site: AMERT, CLYDE OH. Elevation: Pad N/A Top of PVC Casing 681.62'

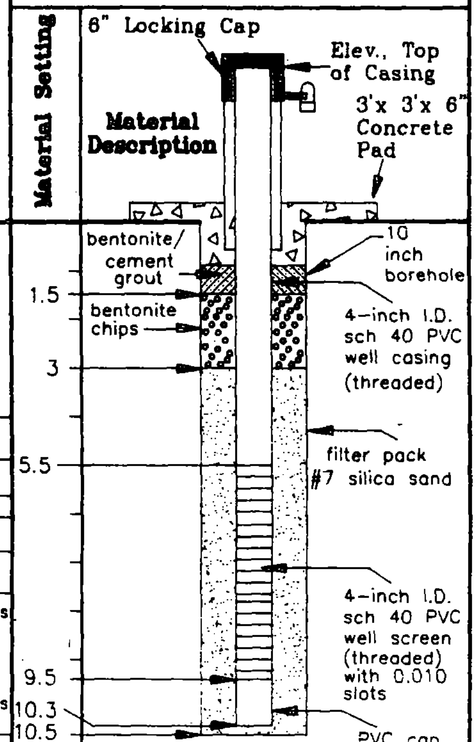
Total Depth: 10.5 FEET Casing Size & Type: 4" SCH 40 PVC Screen Size: 0.010 INCH

Comments: 8 INCH AND 10 INCH HOLLOW STEM AUGER
2-FEET SPLIT-SPOON SAMPLER

Depth in Feet	PID (ppm)	Symbol	Sample Description
	0.0	SW	SAND, yellowish brown, fine-medium sand, well graded, roots, moist
	0.0	SW	SAND, pale brown, fine-medium sand, well graded, roots, moist-wet
		SW	SILTY SAND, yellowish brown, coarse-very coarse, sand with silt (20-40%) wet
5		CL	SANDY CLAY, yellowish brown, clay, moderate plasticity with sand, very coarse, rock fragments, wet
		SW	SILTY SAND, coarse-very coarse sand with silt, very well graded, wet
	0.0	SW	SAND, coarse-very coarse sand, very well graded, saturated, trace fines
	0.3	SW	CLAYEY GRAVELLY SAND, yellowish brown, medium-coarse sand with clay and gravel wet-saturated
	0.0	SW	GRAVELLY SAND, gray, fine-medium sand, very well graded with trace fines and (30-40%) gravel, up to 1/2" diameter, saturated
10	0.0	SW	GRAVELLY SAND, gray, fine-medium sand, very well graded with trace fines saturated, with (20-30%) gravel up to 1/4"

TOTAL DEPTH = 10.5 FEET

Completion Data



DRAWN BY	WAL	12/27/89	CHECKED BY	MB	1/12/90	APPROVED BY	MB	1/12/90	DRAWING NUMBER	446493-A23

INTERNATIONAL TECHNOLOGY CORPORATION

Monitor Well Installation

Well No.: MW4

Client: WHIRLPOOL Job No.: 446493 Date Drilled: 12/1/89 Sheet 1 of 1

Site: AMERT, CLYDE OH. Elevation: Pad N/A Top of PVC Casing 681.56'

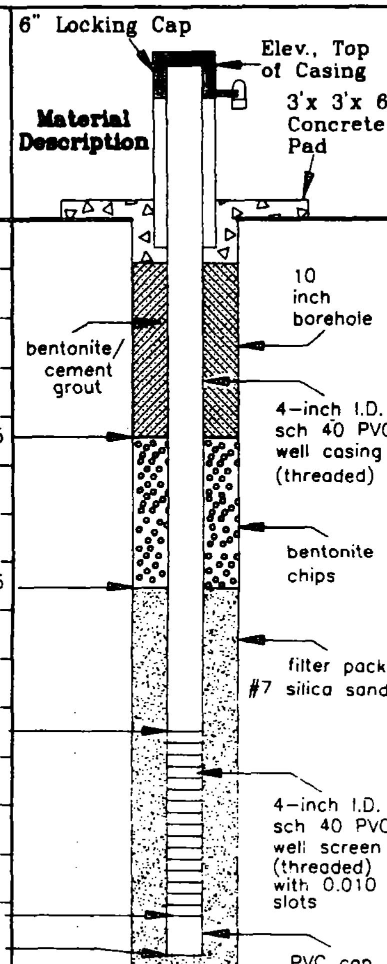
Total Depth: 15.5 FEET Casing Size & Type: 4" SCH 40 PVC Screen Size: 0.010 INCH

Comments: 8 INCH AND 10 INCH HOLLOW STEM AUGER
2 - FOOT SPLIT SPOON SAMPLER

Depth in Feet	PID (ppm)	Symbol	Sample Description	Material Setting
		SW	SAND, yellowish brown, fine–medium sand, well graded, roots, moist	
	0.0			
		SW	SAND, pale brown, fine–medium sand, well graded, roots, moist–wet	
	0.0			
		SW	SILTY SAND, yellowish brown, coarse–very coarse, sand with silt (20–40%) wet	4.5
5		CL	SANDY CLAY, yellowish brown, clay, moderate plasticity with sand, very coarse, rock fragments, wet	
		SW	SILTY SAND, coarse–very coarse sand with silt, very well graded, wet	
	0.0	SW	SAND, coarse–very coarse sand, very well graded, saturated, trace fines	
	0.3	SW	CLAYEY GRAVELLY SAND, yellowish brown, medium–coarse sand with clay and gravel wet–saturated	7.5
	0.0	SW	GRAVELLY SAND, gray, fine–medium sand, very well graded with trace fines and (30–40%) gravel up to 1/2" diameter, saturated	
10	0.0	SW	GRAVELLY SAND, gray, fine–medium sand, very well graded with trace fines saturated, with (20–30%) gravel up to 1/4" diameter	10.4
	0.0	SW		
	0.0	SW	GRAVELLY SAND, gray, fine–medium sand, very well graded with trace fines saturated, with (20–30%) gravel up to 1/2" diameter	
			GRAVELLY SAND, gray, fine–medium sand, very well graded with trace fines saturated, with (20–30%) gravel up to 1/2" diameter	14.3
15		ML	CLAYEY SILT, gray, silt with clay (20–30%), very firm, intermittant rock fragments	15.2 15.5

TOTAL DEPTH = 15.5 FEET

Completion Data



DRAWN BY	WAL	12/27/89	CHECKED BY	VMB	11/12/90	APPROVED BY	VMB	11/12/90	DRAWING NUMBER	446493–A24

INTERNATIONAL TECHNOLOGY CORPORATION

Monitor Well Installation

Well No.: MW5

Client: WHIRLPOOL Job No.: 446493 Date Drilled: 12/01/89 Sheet 1 of 1

Site: AMERT, CLYDE OH. Elevation: Pad N/A Top of PVC Casing 687.07'

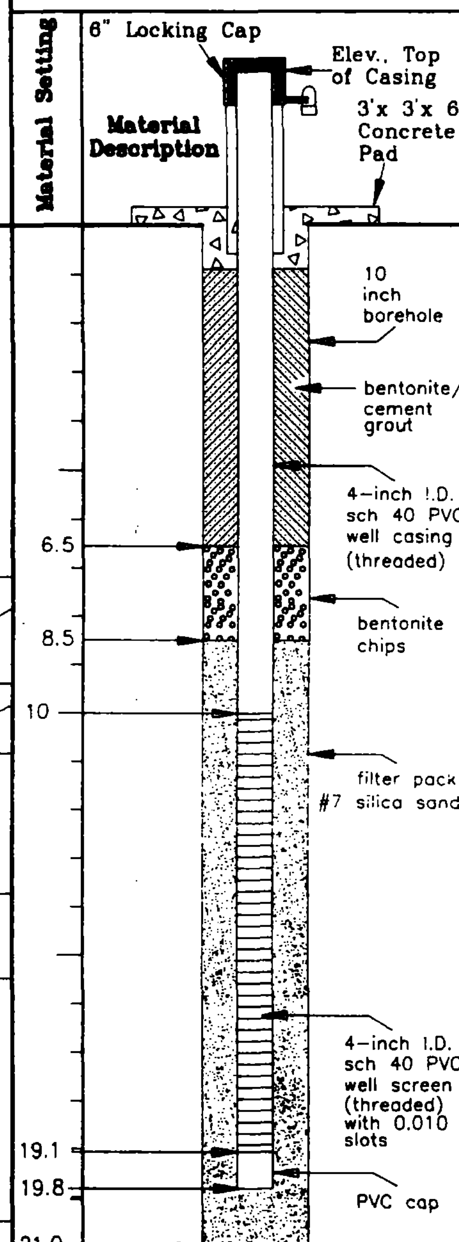
Total Depth: 21.0 FEET Casing Size & Type: 4" SCH 40 PVC Screen Size: 0.010 INCH

Comments: 8 INCH AND 10 INCH HOLLOW STEM AUGER
2-FOOT SPLIT-SPOON CONTINUOUS SAMPLER

Depth in Feet	PID (ppm)	Symbol	Sample Description
	0.0	SW	SAND, yellowish brown, medium sand, well graded, roots, moist
	0.0	SW	SAND, yellowish brown, medium sand, well graded, roots, moist
5	0.0	SW	SAND, brownish yellow, fine-medium sand, moderately graded, roots, moist
		SW	SAND, brownish yellow, fine-medium sand, moderate-poorly graded, moist
	0.0	SW	GRAVELLY SAND, pale brown, very coarse sand, with gravel up to 3/8" some fine-medium sand, very well graded
		SW	SAND, fine-medium sand
10	0.0	SW	CLAYEY GRAVELLY SAND, yellowish brown, medium-coarse sand with clay, moderate plasticity and gravel, some peat present
		SW	SAND, yellowish brown, medium-coarse sand, well graded, wet-saturated
	0.0	SW	GRAVELLY SAND, gray, fine-medium sand, very well graded, saturated, some olive coloring
		SW	GRAVELLY SAND, gray, fine-medium sand, with gravel layers throughout very well graded, saturated
15	0.0	SW	SAND, olive gray, fine-medium sand, well graded, with gravel scattered throughout, saturated
		SW	SAND, gray, fine-medium sand, moderate-well graded, saturated.
	0.0	SW	SAND, gray, fine-medium sand, moderate-well graded, some gravel throughout
20		SW	SAND, gray, fine-medium sand, very well graded, fines, coarse, saturated
		ML	CLAYEY SILT, gray, silt with clay (20-30%), very firm, scattered gravel

TOTAL DEPTH = 21.0 FEET

Completion Data



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INTERNATIONAL TECHNOLOGY CORPORATION

Monitor Well Installation

Well No.: MW6

Client: WHIRLPOOL   Job No.: 446493   Date Drilled: 11/30/89   Sheet 1 of 1

Site: AMERT, CLYDE OH.   Elevation: Pad N/A   Top of PVC Casing 687.75'

Total Depth: 14.5 FEET   Casing Size & Type: 4" SCH 40 PVC   Screen Size: 0.010 INCH

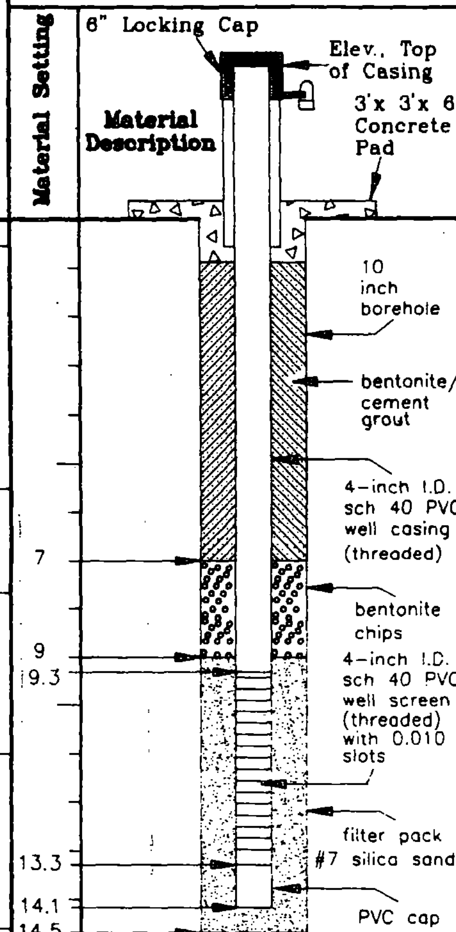
Comments: 8 INCH AND 10 INCH HOLLOW STEM AUGER
2 - FOOT SPLIT-SPOON AND 5 FOOT CONTINUOUS SAMPLER

Depth in Feet	PID (ppm)	Symbol	Stratigraphy	Sample Description
		SW		CLAYEY SAND, brown, fine-medium sand with clay, roots
	0.1	SW		SAND, yellowish brown, fine-medium sand, well graded, moist
5	0.1 0.3	SW		SAND, yellowish brown, medium sand, well graded, moist
	0.1	SW		SAND, brown, fine-medium sand, well graded, trace fines, roots
10	0.3	SW		CLAYEY SAND, pale gray, fine-medium sand with clay (20-40%), scattered rock fragments, and some brownish-orange staining, moderately firm, moist
	0.1	SW		SAND, brownish gray, fine-medium sand, well graded, saturated

TOTAL DEPTH = 14.5 FEET

Completion Data

Material Setting | Material Description



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INTERNATIONAL TECHNOLOGY CORPORATION

Monitor Well Installation

Well No.: MW7

Client: WHIRLPOOL Job No.: 446493 Date Drilled: 11/30/89 Sheet 1 of 1

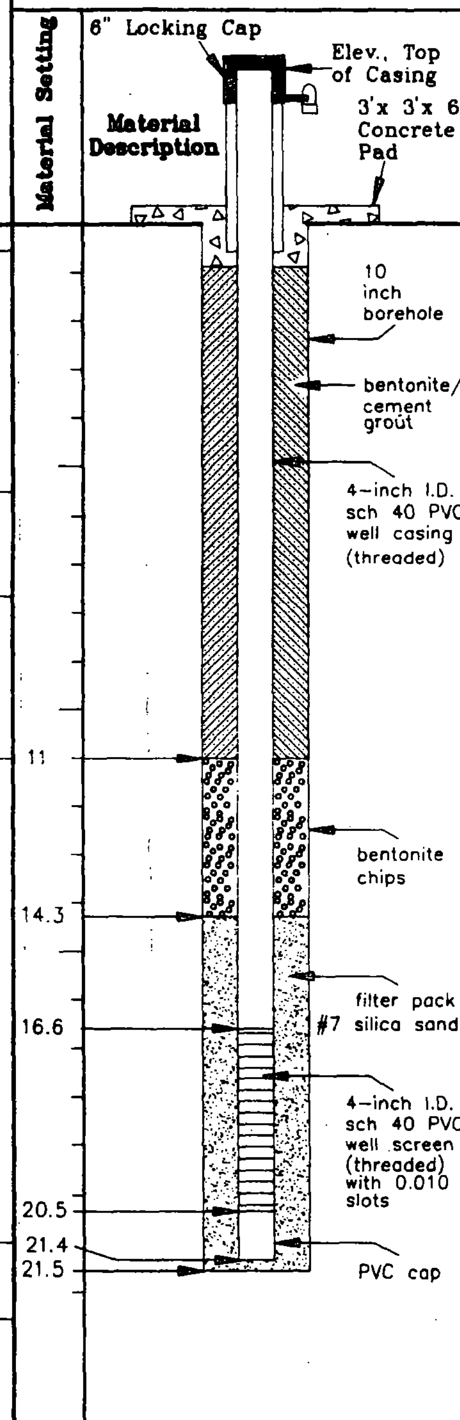
Site: AMERT, CLYDE OH. Elevation: Pad N/A Top of PVC Casing 687.70'

Total Depth: 21.5 FEET Casing Size & Type: 4" SCH 40 PVC Screen Size: 0.010 INCH

Comments: 8 INCH AND 10 INCH HOLLOW STEM AUGER
2' - SPLIT-SPOON AND 5 FOOT CONTINUOUS SAMPLER

Depth in Feet	PID (ppm)	Symbol	Stratigraphy	Sample Description
		SW		CLAYEY SAND, brown, fine-medium sand with clay, roots
	0.1	SW		SAND, yellowish brown, fine-medium sand, well graded, moist
	0.1	SW		SAND, yellowish brown, medium sand, well graded, moist
5	0.3			
		SW		SAND, brown, fine-medium sand, well graded, trace fines, roots
	0.1			
		SW		CLAYEY SAND, pale gray, fine-medium sand with clay (20-40%) scattered rock fragments, some brownish-orange staining, moderately firm, moist
	0.3			
10				
				SAND, brownish gray, fine-medium sand, well graded, saturated
	C.1	SW		
15				
		SW		SAND, brownish gray, fine-medium sand, well graded, saturated
	0.1			
20				
				SAND, brownish gray, fine-medium sand, well graded, saturated
	0.1	ML		CLAYEY SILT, gray, silt with clay (20-30%), very firm, moist, scattered rock fragments
				TOTAL DEPTH = 21.5 FEET

Completion Data



DRAWN BY	WAL	12/28/89	CHECKED BY	MB	1/12/90	APPROVED BY	MB	1/12/90	DRAWING NUMBER	446493-A27

INTERNATIONAL TECHNOLOGY CORPORATION

Monitor Well Installation

Well No.: MW8

Client: WHIRLPOOL Job No.: 446493 Date Drilled: 11/30/89 Sheet 1 of 1

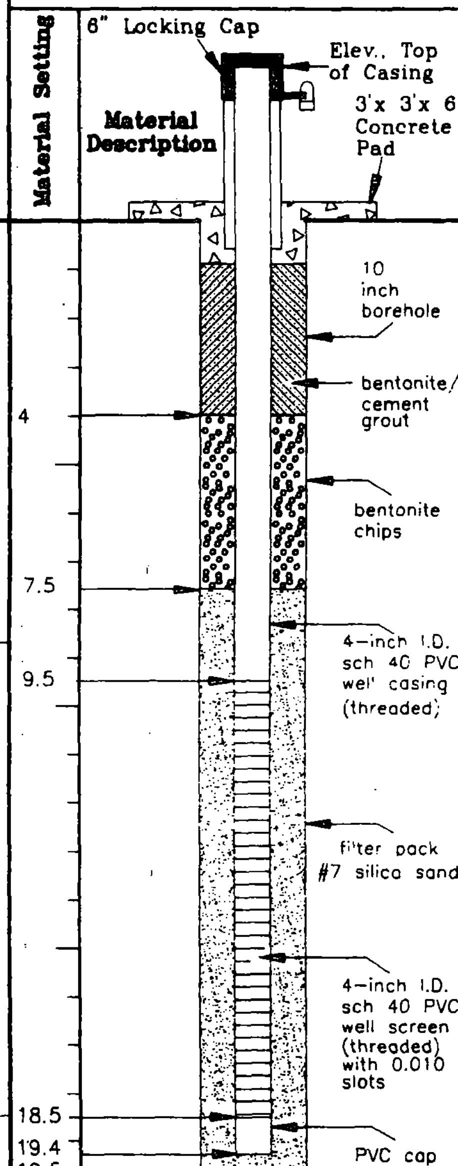
Site: AMERT, CLYDE OH. Elevation: Pad N/A Top of PVC Casing 686.05'

Total Depth: 19.5 FEET Casing Size & Type: 4" SCH 40 PVC Screen Size: 0.010 INCH

Comments: 8 INCH AND 10 INCH HOLLOW STEM AUGER
2'- FOOT SPLIT-SPOON SAMPLER

Depth in Feet	PID (ppm)	Symbol	Stratigraphy	Sample Description
	0.1	SW		SAND, yellowish brown, fine-medium sand, well graded, roots, moist
	0.3	SW		SAND, yellowish brown, fine-medium sand, well graded, roots, moist
5	0.1	SW		SAND, yellowish brown, fine-medium sand, well graded, roots, moist, some orange staining
	0.3	SW		SAND, yellowish brown, fine-medium sand, well graded, wet-saturated, some orange staining
	0.7	SW		SAND, brownish gray, fine-medium sand, well graded, saturated
10				
	0.3	SW		SAND, brownish gray, fine-medium sand, well graded, saturated
15				
				SAND, brownish gray, fine-medium sand, well graded, saturated
	0.1			
	0.5	SW		SAND, brownish gray, fine-medium sand, well graded, saturated
		ML		CLAYEY SILT, silt with clay (20-30%), very firm, moist, scattered rock fragments
20				TOTAL DEPTH = 19.5 FEET

Completion Data



DRAWN BY	WAL	12/28/89	CHECKED BY	MB	11/12/90	APPROVED BY	MB	11/12/90	DRAWING NUMBER	446493-A28

INTERNATIONAL TECHNOLOGY CORPORATION

Monitor Well Installation

Well No.: MW9

Client: WHIRLPOOL Job No.: 446493 Date Drilled: 12/02/89 Sheet 1 of 1

Site: AMERT, CLYDE OH. Elevation: Pad N/A Top of PVC Casing 688.16

Total Depth: 19.9 FEET Casing Size & Type: 4" SCH 40 PVC Screen Size: 0.010 INCH

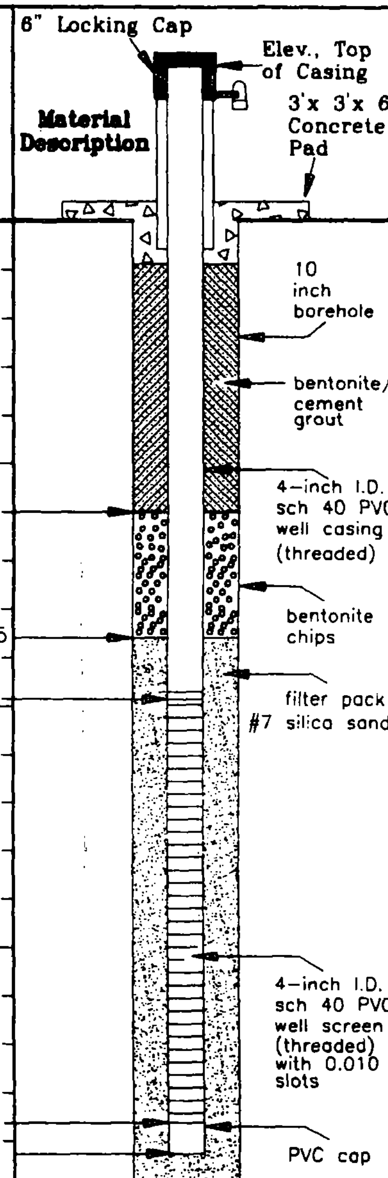
Comments: 8 INCH AND 10 INCH HOLLOW STEM AUGER
2 – FOOT SPLIT-SPOON CONTINUOUS SAMPLER

Depth in Feet	PID (ppm)	Symbol	Stratigraphy	Sample Description	Material Setting
	0.0	SW		SAND, yellowish brown, fine-medium sand, well graded, roots, moist, trace of fines.	
	0.0	SW		SAND, brown, fine-medium sand, well graded, roots, moist, trace of fines	
5	0.0	SW		SAND, brownish yellow, fine-medium sand, well graded, trace fines, moist, roots.	
		SW		SAND, yellowish brown, medium-coarse sand, very well graded, moist	6
	0.0	SW		SAND, yellowish brown, fine-medium sand, well graded, moist-wet	
		SW		SILTY GRAVELLY SAND, yellowish brown, fine-medium sand, well graded, coarse sand with silt (20-30%) and gravel, wet	
	0.0	SW		GRAVELLY SAND, yellowish brown, medium-coarse sand with gravel, wet	8.5
		SW		SAND, yellowish brown, medium sand, very well graded, trace fines, saturated.	9.9
10	0.0	SW		GRAVELLY SAND, gray, fine-medium sand with gravel layers throughout, saturated	
	0.0				
	0.0	SW		GRAVELLY SAND, gray, fine-medium sand with gravel throughout, saturated	
15					
	0.0	SW		GRAVELLY SAND, gray, fine-medium sand with gravel throughout, saturated	
	0.0	SW		GRAVELLY SAND, gray, fine-medium sand with gravel, saturated	18.8
	0.0	ML		CLAYEY SILT, gray, silt with clay (20-30%), very firm, scattered rock fragment	19.4
20					19.9

TOTAL DEPTH = 19.9 FEET

Completion Data

Material Description



DRAWN BY	WAL	12/28/89	CHECKED BY	MB	11/12/90	APPROVED BY	MB	11/12/90	DRAWING NUMBER	446493-A29

INTERNATIONAL TECHNOLOGY CORPORATION

Monitor Well Installation

Well No.: MW10

Client: WHIRLPOOL Job No.: 446493 Date Drilled: 12/03/89 Sheet 1 of 1

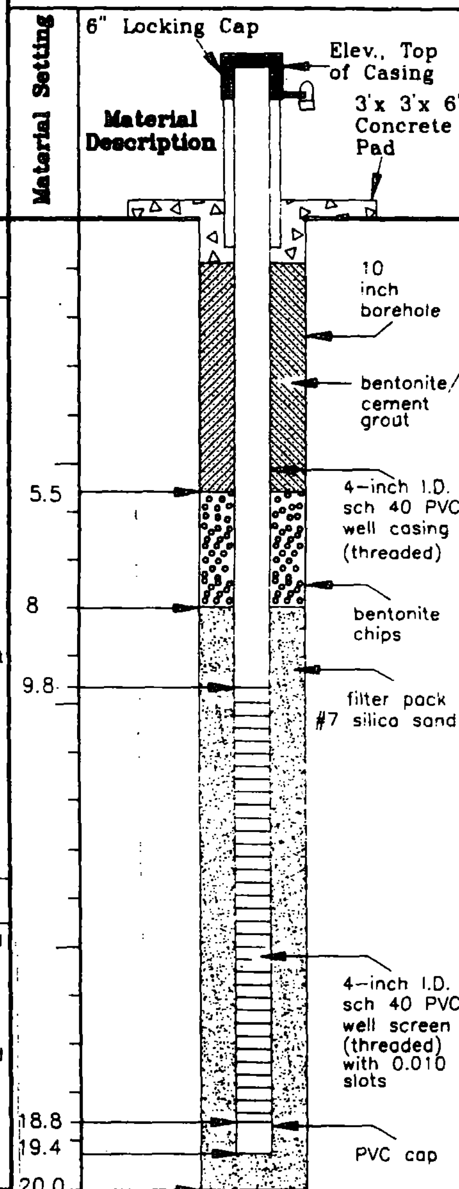
Site: AMERT, CLYDE OH. Elevation: Pad N/A Top of PVC Casing 690.30'

Total Depth: 20.0 FEET Casing Size & Type: 4" SCH 40 PVC Screen Size: 0.010 INCH

Comments: 8 INCH AND 10 INCH HOLLOW STEM AUGER
2' – SPLIT-SPOON SAMPLER

Depth in Feet	PID (ppm)	Symbol	Stratigraphy	Sample Description
		GW		SANDY GRAVEL, pale brown, fill
	0.0	SW		SAND, yellowish brown, fine–medium sand, well graded, moist, roots
5	0.0	SW		SAND, yellowish brown, fine–medium sand, well graded, moist, roots
	0.0	SW		SAND, yellowish brown, fine–medium sand, moderate–well graded, black and deep red staining 7.5'– 8'
	0.0	SW		SAND, yellowish brown, fine–medium sand, moderate–well graded, moist–wet
10	0.0	SW		SAND, light brown, fine–medium sand, moderate–well graded, saturated at 10.5' and below
	0.0	SW		SAND, light brown, fine–medium sand, moderate–well graded.
		SW		SILTY SAND, gray, fine sand with silt (20–30%) laminated, saturated
15	0.0	SW		GRAVELLY SAND, gray, fine–medium sand with gravel throughout, saturated
		SW		GRAVELLY SAND, gray, fine–medium sand with gravel throughout, saturated
		SW		GRAVELLY SAND, fine–medium sand with gravel throughout, saturated
		ML		CLAYEY SILT, gray, silt with clay (20–30%) very firm gravel, rock fragment throughout, moist
20				TOTAL DEPTH = 20.0 FEET

Completion Data



DRAWN BY	WAL	12/28/89	CHECKED BY	MB	11/12/90	APPROVED BY	MB	11/12/90	DRAWING NUMBER	446493–A30

INTERNATIONAL TECHNOLOGY CORPORATION

Monitor Well Installation

Well No.: MW-11 (SB-3)

Client: WHIRLPOOL Job No.: 446493 Date Drilled: 12/04/89 Sheet 1 of 2

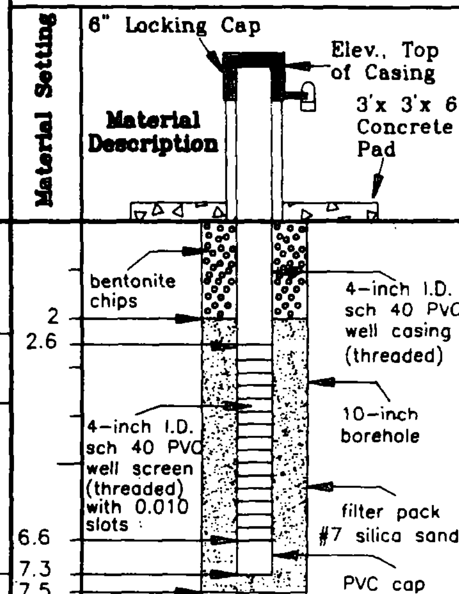
Site: AMERT, CLYDE OH. Elevation: Pad N/A Top of PVC Casing 674.03'

Total Depth: 30.5 FEET Casing Size & Type: 4" SCH 40 PVC Screen Size: 0.010 INCH

Comments: 8 INCH HOLLOW STEM AUGER
2 – FOOT SPLIT-SPOON AND 5 FOOT CONTINUOUS SAMPLER

Depth in Feet	PID (ppm)	Symbol	Stratigraphy	Sample Description
	0.0	SW		SILTY SAND, brown, fine–medium sand, moderately graded with silt (20–40%), wet
	0.0	SW		SAND, brown, fine–medium sand, moderately graded, saturated
		SW		GRAVELLY SAND, grayish brown, fine–coarse sand, very well graded with gravel up to 1/2" diameter
5	0.0			
	ND	SW		
		ML		CLAYEY SILT, gray, silt with clay (20–30%), very firm, moist, gravel scattered throughout
	0.0			
10	0.0	ML		CLAYEY SILT, gray, silt with clay (20–30%), very firm, moist, some rock fragments
	0.0	ML		CLAYEY SILT, gray, at 12.7' BGL a 1/2" layer of medium–coarse sand
15				
		ML		CLAYEY SILT, gray, silt with clay (20–30%), very firm, moist.
	0.0	SW		SAND, gray, medium sand with fines, saturated, well graded
		ML		CLAYEY SILT, gray, silt with clay (20–30%), very firm, moist, rock fragment scattered throughout
20				
	0.0	SW		SAND, gray, medium sand moderately graded, 10% fines, wet
		ML		CLAYEY SILT, gray, silt with clay (20–30%), very firm, rock fragments
		SW		SAND, gray, medium sand moderately graded, 10% fines, wet
		ML		CLAYEY SILT, gray, silt with clay (20–30%), very firm, moist, some rock fragments
25				

Completion Data



Note: Log from boring SB-3, 5 feet away from MW-11.

DRAWN BY	WAL	01/02/90	CHECKED BY	MS	1/12/90	APPROVED BY	MB	1/12/90	DRAWING NUMBER 446493-A31a

INTERNATIONAL TECHNOLOGY CORPORATION

Monitor Well Installation

Well No.: MW-11 (SB-3)

Client: WHIRLPOOL Job No.: 446493 Date Drilled: 12/04/89 Sheet 2 of 2

Site: AMERT, CLYDE OH. Elevation: Pad N/A Top of PVC Casing 674.03'

Total Depth: 30.5 FEET Casing Size & Type: 4" SCH 40 PVC Screen Size: 0.010 INCH

Comments: 8 INCH HOLLOW STEM AUGER
2' - SPLIT-SPOON AND 5 FOOT CONTINUOUS SAMPLER

Depth in Feet	PID (ppm)	Symbol	Stratigraphy	Sample Description	Completion Data: Material Setting	
		ML		CLAYEY SILT, gray, silt with clay (20-30%), very firm, moist, some rock fragments		
30		ML			30.5	
				TOTAL DEPTH = 30.5 FEET		
40						

Note: Log from boring SB-3 is 5 feet away from boring for MW-11.

DRAWN BY	WAL	01/02/90	CHECKED BY	VMB	11/12/90	APPROVED BY	VMB	11/12/90	DRAWING NUMBER	446493-A31b

INTERNATIONAL TECHNOLOGY CORPORATION

Monitor Well Installation

Well No.: MW12

Client: WHIRLPOOL Job No.: 446493 Date Drilled: 12/04/89 Sheet 1 of 1

Site: AMERT, CLYDE OH. Elevation: Pad N/A Top of PVC Casing 669.20'

Total Depth: 4.0 FEET Casing Size & Type: 4" SCH 40 PVC Screen Size: 0.010 INCH

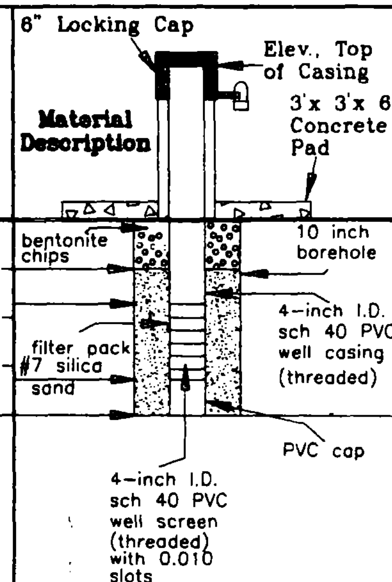
Comments: 8 INCH AND 10 INCH HOLLOW STEM AUGER
2 - FOOT SPLIT-SPOON SAMPLER

Depth in Feet	PID (ppm)	Symbol	Stratigraphy	Sample Description
	0.0	SW		SILTY SAND, brown, fine-medium sand, with silt, well graded, roots, moist-wet
		SW		CLAYEY SAND, yellowish brown, medium sand with clay, moderately graded, wet.
	0.0	SW		GRAVELLY SAND, gray, fine-medium sand, well graded, saturated, gravel throughout.
4.0				TOTAL DEPTH = 4.0 FEET
5	0.0	ML		CLAYEY SILT, gray

TOTAL DEPTH OF BORING = 4.0 FEET

Completion Data

Material Setting
1
1.8
3.8
4



DRAWN BY	WAL	01/02/90	CHECKED BY	MB	4/12/90	APPROVED BY	MB	4/12/90	DRAWING NUMBER	446493-A32

INTERNATIONAL TECHNOLOGY CORPORATION

Monitor Well Installation

Well No.: SB1

Client: WHIRLPOOL Job No.: 446493 Date Drilled: 11/14/89 Sheet 1 of 2

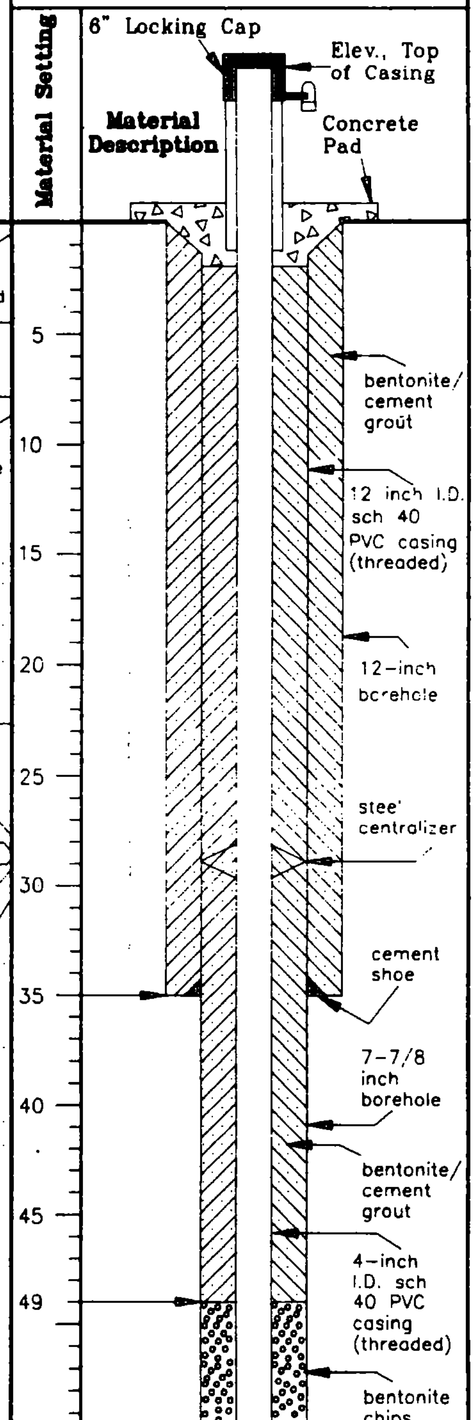
Site: AMERT, CLYDE OH. Elevation: Pad N/A Top of PVC Casing 688.04'

Total Depth: 94.5 FEET Casing Size & Type: 4" & 12" SCH 40 PVC Screen Size: 0.01

Comments: 8 INCH HOLLOW STEM AUGER
2-FOOT SPLIT-SPOON AND 5 FOOT CONTINOUS SAMPLER

Depth in Feet	PID (ppm)	Symbol	Stratigraphy	Sample Description
	0.2	ML		CLAYEY SANDY SILT, brown, silt with very fine sand and trace of clay slightly cohesive, roots
	0.4	SW		SAND, yellowish brown, fine-medium sand, some coarse grained, trace fines, well graded, moist, 75% quartz, 25% dark minerals, subrounded
5	0.2 / 0.4	SW		SILTY SAND, brown, fine-medium sand with silt (10-20%), well graded, roots
		SW		SILTY SAND, pale brown, fine-medium sand with trace of silt, well graded
		SW		CLAYEY SILTY SAND, pale brown, fine-medium sand with silt and clay, moderately cohesive, iron staining, black nodules up to 1/8", roots
10	0.6			SILTY SAND, grayish brown, medium coarse sand with silt, slightly cohesive trace of clay, some very coarse sand, wet-saturated
				GRAVELLY SAND, grayish brown, medium coarse sand with gravel up to 3/8", predominately 1/8", saturated, very well graded
15				
20				
		ML		CLAYEY SILT, gray, silt with clay (10-20%), some rock fragments, stiff-hard, homogenous
25				CLAYEY SILT, gray
		SW		SILTY SAND, gray, sand medium-coarse with silt (10-20%)
		ML		GRAVELLY SILT, gray, silt, very dense with gravel (20-30%), up to 3/8"
		SW		SILTY SAND, gray, medium-coarse sand with silt (10-20%)
30		ML		GRAVELLY SILT, gray, silt, very dense with clay (10-30%), and gravel (10-20%), very firm, moist-dry
		ML		CLAYEY SILT, gray, silt with clay, low plasticity
35				
40				
45				
50				
55				

Completion Data



DRAWN BY	WAL	1/25/90	CHECKED BY	VMS	11/12/90	APPROVED BY	VMS	11/12/90	DRAWING NUMBER	446493-A33a

INTERNATIONAL TECHNOLOGY CORPORATION

Monitor Well Installation

Well No.: SB1

Client: WHIRLPOOL Job No.: 446493 Date Drilled: 11/18/89 Sheet 2 of 2

Site: AMERT CLYDE OH. Elevation: Pad N/A Top of PVC Casing 688.04'

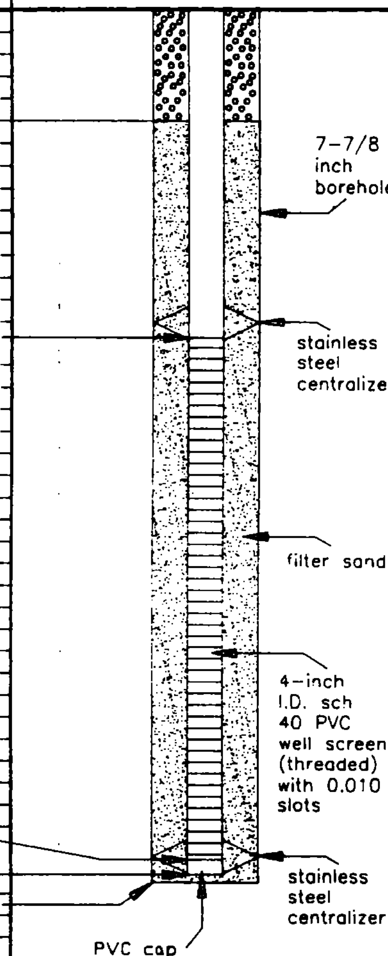
Total Depth: 94.5 FEET Casing Size & Type: 12" & 4" SCH 40 PVC Screen Size: 0.010

Comments: 8-INCH HOLLOW STEM AUGER
2-FOOT SPLIT-SPOON AND 5 FOOT CONTINUOUS SAMPLER

Depth in Feet	PID (ppm)	Symbol	Stratigraphy	Sample Description
60		ML		CLAYEY SILT, gray, silt with clay, low plasticity
65–70		ML		GRAVELLY CLAYEY SILT, gray, silt with clay, increase in gravel.
75				LIMESTONE, pale gray
80				LIMESTONE, pale gray
85–90				LIMESTONE, pale gray
95				TOTAL DEPTH = 94.5 FEET
100				

Completion Data

Material Setting | Material Description



DRAWN BY	WAL	1/25/90	CHECKED BY	MB	11/12/90	APPROVED BY	MB	11/12/90	DRAWING NUMBER	446493-A33b

LOG OF BORING

BORING NO.: SB2

CLIENT: WHIRLPOOL JOB NO.: 446493 SHEET 1 OF 2

SITE: AMERT-CLYDE OHIO DATE: START 11/15/89 FINISH 11/16/89

INSPECTOR: LEE GARRETT DRILLER: IT CORP. DRILL RIG TYPE: MOBILE B-61

MEASURED GROUND-WATER LEVEL: N/A DEPTH 84.6 FEET DATE 11/16/89

DRILLING METHODS: MUD ROTARY

COMMENTS: 2 - FOOT SPLIT SPOON

DEPTH IN FEET	RECOVERY (1)	SYMBOL (2)	STRATIGRAPHY	SAMPLE DESCRIPTION
0		SW		SAND, light gray, fine-medium sand, well graded, (from cuttings)
5				
10	24/0			SAND, light gray, fine-medium sand, well graded, (from cuttings)
15				
20	24/18	ML		CLAY SILT, brownish gray, silt with clay (10-20%), very dense some rock fragments up to 1/2" diameter
25				
30	20/4	ML		CLAYEY GRAVELLY SILT, brownish gray, silt with clay (10-30%), very dense and firm, with gravel (12-20%), gravel is 1/8" diameter average, damp
35				
40	24/22	ML		CLAYEY GRAVELLY SILT, brownish gray, silt with clay (10-30%), very dense, very hard with gravel (10-20%) moist
45				
50	24/20	ML		CLAYEY GRAVELLY SILT, brownish gray, silt with clay (10-30%), very dense, very firm, moist, with gravel (10-20%), scattered throughout
55				

(1) UNIFIED SOIL CLASSIFICATION SYSTEM

DRAWN BY	WAL	1/25/90	CHECKED BY	MB	4/12/90	APPROVED BY	MB	4/12/90	DRAWING NUMBER	446493-A40A

LOG OF BORING

BORING NO.: SB2

CLIENT: WHIRLPOOL JOB NO.: 446493 SHEET 2 OF 2

SITE: AMERT-CLYDE OHIO DATE: START 11/15/89 FINISH 11/16/89

INSPECTOR: LEE GARRETT DRILLER: IT CORP. DRILL RIG TYPE: MOBILE B-61

MEASURED GROUND-WATER LEVEL: N/A DEPTH 84.6 FEET DATE 11/16/89

DRILLING METHODS: MUD ROTARY

COMMENTS: 2 - FOOT SPLIT SPOON

DEPTH IN FEET	RECOVERY (1)	SYMBOL (2)	STRATIGRAPHY	SAMPLE DESCRIPTION
	24/20 0			CLAYEY GRAVELLY SILT, brownish gray, silt with clay (10-30%), very dense, very firm, moist, with gravel (10-20%), scattered throughout
65				
70	9 0			
				LOST SS. SHOE DOWN HOLE-DID NOT GET A SAMPLE
75				
80				LIMESTONE, pale brown - gray
85				TOTAL DEPTH = 84.6 FEET
90				

(1) UNIFIED SOIL CLASSIFICATION SYSTEM

DRAWN BY	WAL	1/25/90	CHECKED BY	MB	1/12/90	APPROVED BY	MB	1/12/90	DRAWING NUMBER	446493-A40B

LOG OF BORING

BORING NO.: WB1

CLIENT: WHIRLPOOL   JOB NO.: 446493   SHEET 1 OF 1

SITE: AMERT - CLYDE OH.   DATE: START 11/16/89   FINISH 11/16/89

INSPECTOR: LEE GARRET   DRILLER: IT CORP.   DRILL RIG TYPE: MOBIL B-61

MEASURED GROUND-WATER LEVEL: DEPTH 12.0 FEET   DATE 11/16/89

DRILLING METHODS: 8 INCH HOLLOW STEM AUGER

COMMENTS: 2 - FOOT SPLIT SPOON AND 5 FOOT CONTINUOUS SAMPLER

DEPTH IN FEET	RECOVERY (1)	PID (ppm)	SYMBOL (2)	STRATIGRAPHY	SAMPLE DESCRIPTION
	24/16	0.0	SW		SAND, pale brown, medium-coarse sand, roots, wet
			CL		SILTY CLAY, pale brown, clay, low-moderate plasticity, with silt (20-40%) roots
	24/24	0.2			FILL, orange/white/tan, fine grained, clay sized material
5	12/12	0.2			
	60/20		SW		SAND, yellowish brown, medium-coarse sand, well graded, wet
			SW		SAND, dark gray, medium-coarse sand, well graded, wet
10	24/24		SW		SAND, olive, medium-coarse sand, well graded, wet
			SW		GRAVELLY SAND, pale brown, medium-coarse sand with gravel up to 1/4", well graded, wet
			SW		SAND, pale brown, medium-coarse sand, well graded, wet
					TOTAL DEPTH = 12.0 FEET
15					

(1) INCHES DRIVEN / INCHES RECOVERED (2) UNIFIED SOIL CLASSIFICATION SYSTEM

DRAWN BY	WAL	1/26/90	CHECKED BY	MB	11/12/90	APPROVED BY	11/12/90	MB	DRAWING NUMBER	446493-A41

IT LOG OF BORING

BORING NO.: WB2

CLIENT: WHIRLPOOL JOB NO.: 446493 SHEET 1 OF 1

SITE: AMERT – CLYDE OH. DATE: START 11/16/89 FINISH 11/16/89

INSPECTOR: LEE GARRETT DRILLER: DRILL RIG TYPE: MOBILE B-61

MEASURED GROUND-WATER LEVEL: N/A DEPTH 8.0 FEET DATE 11/16/89

DRILLING METHODS: 8 INCH HOLLOW STEM AUGER

COMMENTS: 2-FOOT SPLIT SPOON AND 5 FOOT CONTINUOUS SAMPLER

DEPTH IN FEET	RECOVERY (1)	SYMBOL (2)	STRATIGRAPHY	SAMPLE DESCRIPTION
	24	SW		SAND, yellowish brown, fine to medium, well graded
	12	CL		SILTY CLAY, brown, low plassticity with silt (20–40%), roots
	24 / 12			FILL, tan/orange/white, very fine clay sized material, stratified, some crystaline layers
5	24	SW		SAND, brown, medium to coarse, well graded, wet
	13	CL		CLAY, brown, low to moderate plasticity, dense, roots
	24	SW		SAND, brown, fine to medium, well graded, wet
		SW		SAND, dark gray, fine to medium, well graded
	24	SW		SAND, olive, fine to medium, well graded
				TOTAL DEPTH = 8.0 FEET
10				
15				

(1) INCHES DRIVEN / INCHES RECOVERED (2) UNIFIED SOIL CLASSIFICATION SYSTEM

DRAWN BY	WAL	1/26/90	CHECKED BY	MB	4/12/90	APPROVED BY	MB	4/12/90	DRAWING NUMBER	446493-A43

LOG OF BORING

BORING NO.: WB3

CLIENT: WHIRLPOOL JOB NO.: 446493 SHEET 1 OF 1

SITE: AMERT - CLYDE OH. DATE: START 11/16/89 FINISH 11/16/89

INSPECTOR: LEE GARRETT DRILLER: IT CORP. DRILL RIG TYPE: MOBILE B-61

MEASURED GROUND-WATER LEVEL: N/A DEPTH 8.0 FEET DATE 11/16/89

DRILLING METHODS: 8 INCH HOLLOW STEM AUGER

COMMENTS: 2-FOOT SPLIT SPOON AND 5 FOOT CONTINUOUS SAMPLER

DEPTH IN FEET	RECOVERY (1)	SYMBOL (2)	STRATIGRAPHY	SAMPLE DESCRIPTION
	24/9	SW		SAND yellowish brown, fine to medium, well graded, roots
		CL		SILTY CLAY, brown, low plasticity, firm, dense, roots
	24/24			FILLL, tan/olive/orange/white, very fine material, stratified, some crystalline layers
	24/20	SW		SAND, brown, fine to medium, well graded, wet, roots
5		CL		SILTY CLAY, olive, low plasticity with silt, soft
	24/20	SW		SAND, yellowish brown, fine to medium, well graded
				SAND, brownish yellow, fine to medium, well graded
				TOTAL DEPTH = 8.0 FEET
10				
15				

(1) INCHES DRIVEN / INCHES RECOVERED (2) UNIFIED SOIL CLASSIFICATION SYSTEM

DRAWN BY	WAL	1/26/90	CHECKED BY	MB	11/12/90	APPROVED BY	MB	11/12/90	DRAWING NUMBER	446493-A43

APPENDIX

B

APPENDIX B

SLUG TEST CALCULATIONS

For MW-5

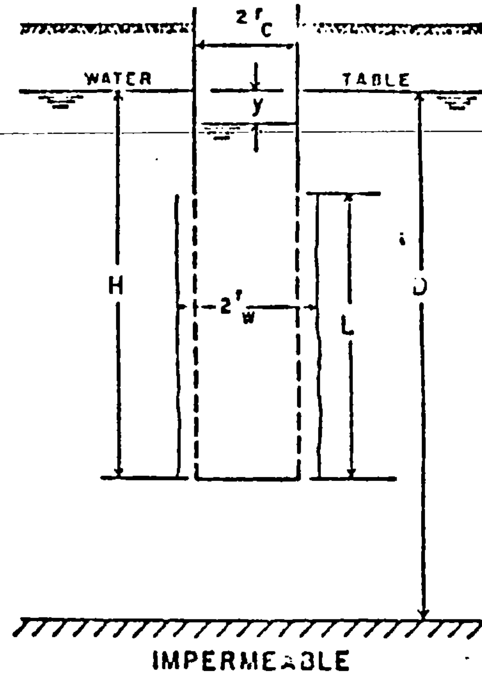
$H =$ 10.46 ft $\quad y_0 =$ 2

$L =$ 9.1 ft $\quad y_t =$ 0.06

$D =$ 11.86 ft $\quad t =$ 60 sec

$2r_c = (2)$ .17 ft = ____ ft

$2r_w = (2)$ .42 ft = ____ ft



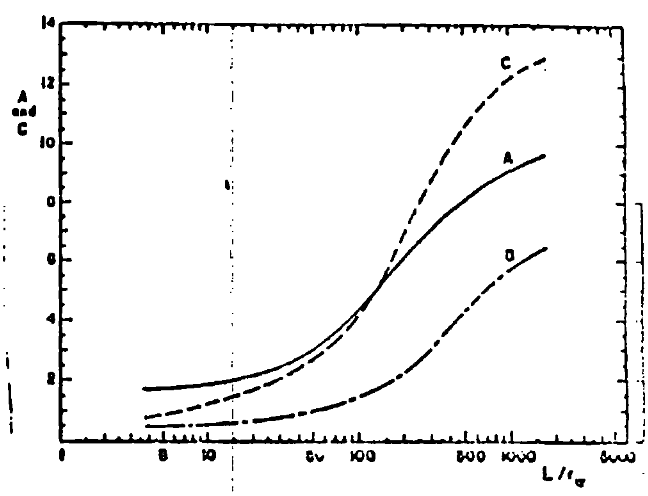
Formulas:

If D > H; then use

F1. $$\ln \frac{R_e}{r_w} = \left[\frac{1.1}{\ln (H/r_w)} + \frac{A + B \ln [(D - H)/r_w]}{L/r_w}\right]^{-1}$$

If D = H; then use

F2. $$\ln R_e/r_w = \left(\frac{1.1}{\ln (H/r_w)} + \frac{C}{L/r_w}\right)^{-1}$$



$\frac{L}{r_w} =$ 21.67

then:

$A =$ 2.25

$B =$ 0.75

$C =$ 1.8

Solution for Hydraulic Conductivity, (K) is:

$$K = \frac{r_c^2 \ln (R_e/r_w)}{2L} \frac{1}{t} \ln \frac{y_0}{y_t}$$

$$K = \frac{[\quad]}{2(\quad)} \cdot \ln \_\_ = \_\_\_\_$$

$K =$ .0002 $\frac{FT}{sec} \cdot 30.477 \frac{cm}{FT} =$ 5.8×10^{-3} $\frac{cm}{sec}$

or ft/day

INTERNATIONAL TECHNOLOGY CORPORATION

By KAH Date 3/16/90 Subject Slug Test - MW-5 Sheet No. 2 of 2

Chkd. By ____ Date ____ Proj. No. 446493.01

$D > H$

$\therefore$

$$\ln {R_e}/{r_w} \quad \left[\frac{1.1}{\ln(H/r_w)} + \frac{A + B \ln\left(\frac{D-H}{r_w}\right)}{L/r_w}\right]^{-1}$$

$L/r_w = 21.67$

$A = 2.25$

$B = 0.75$

$$= \left[\frac{1.1}{3.2151} + \frac{(2.25) + (.75)(1.20)}{21.67}\right]^{-1}$$

$$\left[(.3421) + (0.1455)\right]^{-1}$$

$$\ln {R_e}/{r_w} = 2.05$$

$$K = \frac{r_c^2 \left(\ln R_e/r_w\right)}{2L} \quad \frac{1}{t} \quad \ln\left(\frac{Y_0}{Y_t}\right)$$

$$= \frac{(.17)^2 (2.05)}{18.2} \quad \frac{1}{60} \quad \ln\left(2/.06\right)$$

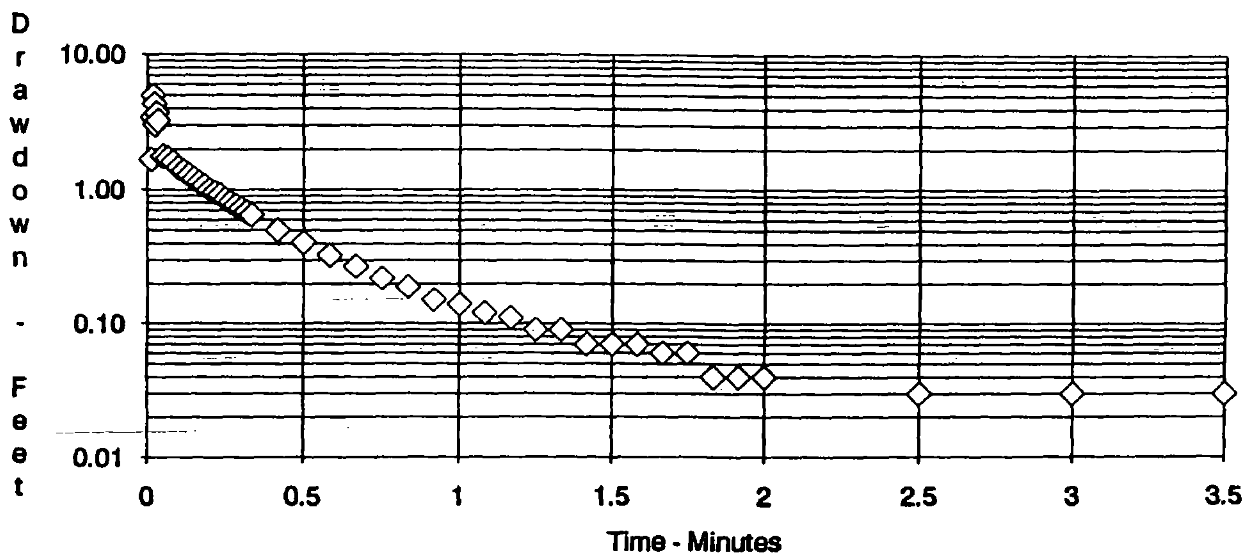
$$(.0033) \quad (.0584)$$

$$= .0002 \text{ ft/sec} \times 30.479 \text{ cm/ft}$$

$$= 5.8 \times 10^{-3} \text{ cm/sec}$$

Do Not Scale This Drawing

DRAWN BY	STF 3/27/90	CHECKED BY APPROVED BY	MB MB	11-12-90 11-12-90	DRAWING NUMBER	446493-A84



SLUG TEST PLOT
MW-5
AMERT SITE INVESTIGATION

PREPARED FOR

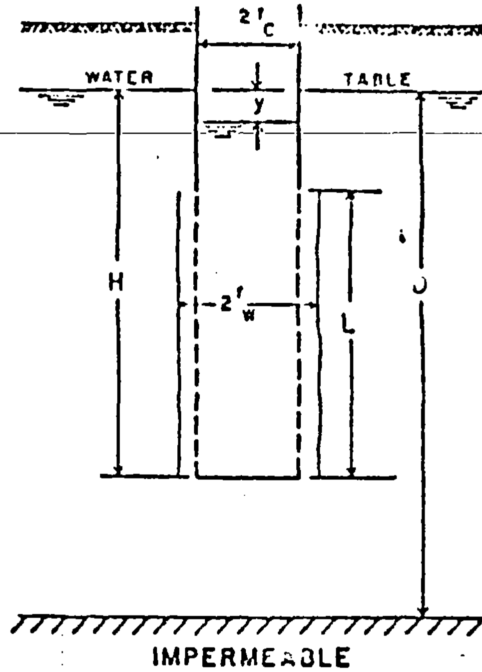
WHIRLPOOL CORPORATION
CLYDE, OHIO

IT

INTERNATIONAL TECHNOLOGY CORPORATION

By KAH Date 3/16/90 Subject Slug Test Calc. for MW- 8 Sheet No. 1 of 2
Chkd. By DM Date 3/23/90 Proj. No.

For MW- 8



$H =$ 10.65 ft $y_0 =$ 2.1

$L =$ 9 ft $y_t =$ 0.35

$D =$ 10.65 ft $t =$ 60 sec

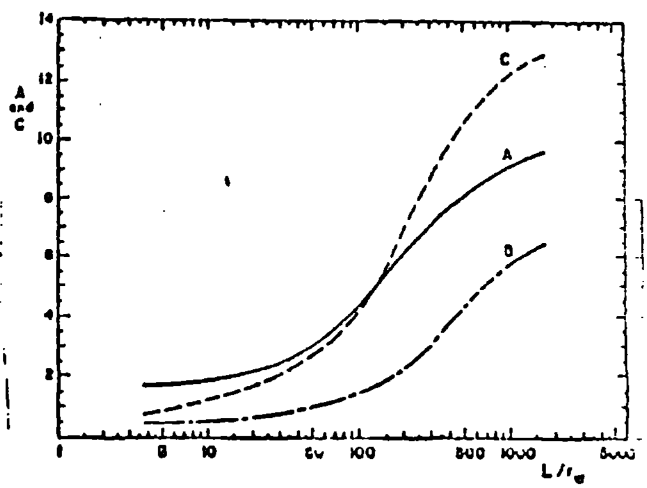
$2r_c = (2)$ .17 ft = ____ ft

$2r_w = (2)$ .42 ft = ____ ft

Formulas:

If $D > H$; then use

F1. $$\ln\frac{R_e}{r_w} = \left[\frac{1.1}{\ln(H/r_w)} + \frac{A + B\ln[(D-H)/r_w]}{L/r_w}\right]^{-1}$$



* If $D = H$; then use

F2. $$\ln R_e/r_w = \left(\frac{1.1}{\ln(H/r_w)} + \frac{C}{L/r_w}\right)^{-1}$$

$\frac{L}{r_w} =$ 21.43

then:

$A =$ ____

$B =$ ____

$C =$ 1.75

Solution for Hydraulic Conductivity, (K) is:

$$K = \frac{r_c^2 \ln(R_e/r_w)}{2L}\frac{1}{t}\ln\frac{y_0}{y_t}$$

$K = \frac{[\quad]}{2(\quad)} \cdot \ln$ ____ = ____

$K =$ .0001 $\frac{ft}{sec} \cdot 30.477 \frac{cm}{ft} =$ 3.5×10^{-3} $\frac{cm}{sec}$

or ft/day

INTERNATIONAL TECHNOLOGY CORPORATION

By KAH Date 3/16/90 Subject Slug Test MW-8 Sheet No. 2 of 2
Chkd. By ____ Date ____ Proj. No. 446493

$D = H$

$$\therefore \ln R_e/r_w = \left(\frac{1.1}{\ln (H/r_w)} + \frac{C}{L/r_w} \right)^{-1}$$

$$L/r_w = 21.43$$

$$C = 1.75$$

$$= \left[\frac{1.1}{3.233} + \frac{1.75}{21.43} \right]^{-1}$$

$$= (.3402 + .0817)$$

$$2.37$$

$$K = \frac{r_c^2 (\ln R_e/r_w)}{2L} \frac{1}{t} \ln \frac{Y_o}{Y_t}$$

$$= \frac{(.17)^2 (2.37)}{18} \cdot \frac{1.792}{60}$$

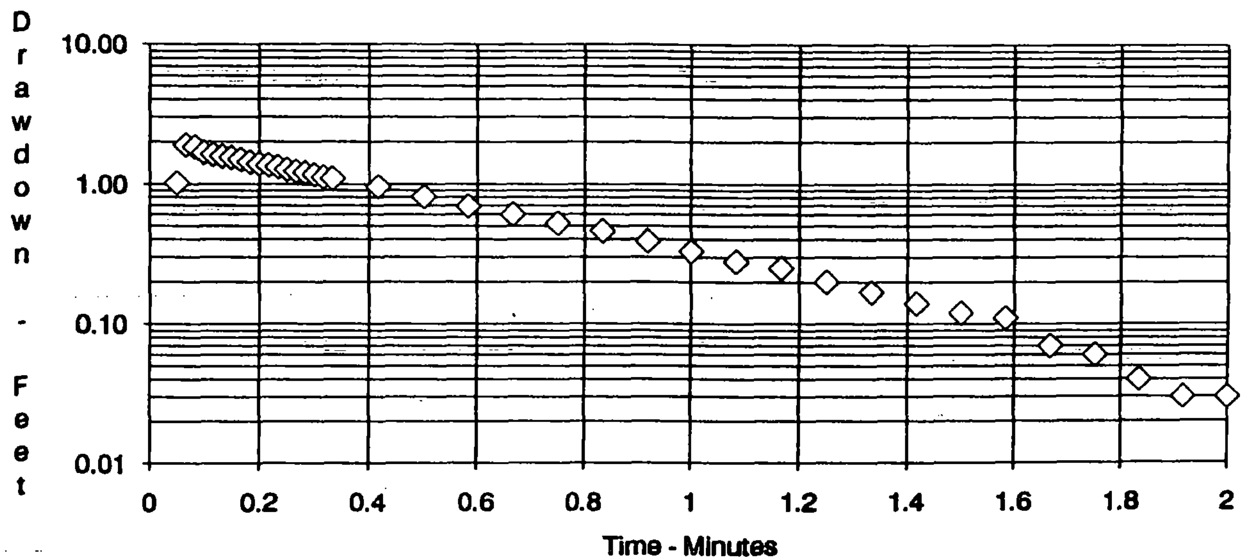
$$= (.0038)(.0299)$$

$$= .0001 \text{ ft/sec} \times 30.479 \text{ cm/ft}$$

$$= 3.5 \times 10^{-3} \text{ cm/sec}$$

Do Not Scale This Drawing

DRAWN BY	STF	CHECKED BY	MB	11-12-90	DRAWING NUMBER	446493-A85
	3/27/90	APPROVED BY	MB	11-12-90		



SLUG TEST PLOT
MW-8
AMERT SITE INVESTIGATION
PREPARED FOR
WHIRLPOOL CORPORATION
CLYDE, OHIO

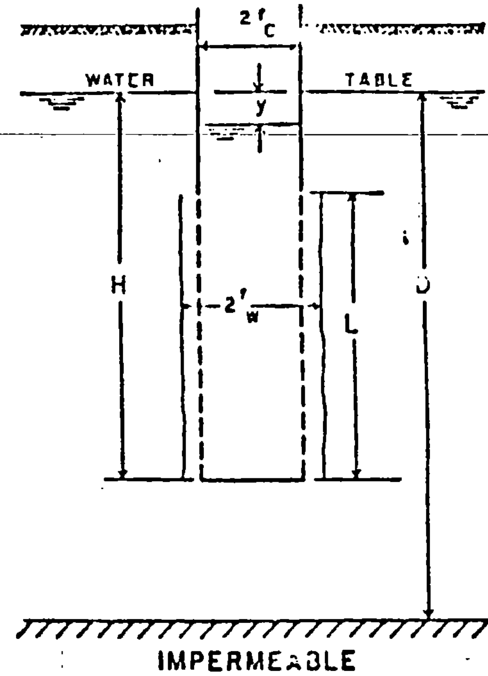
IT

INTERNATIONAL TECHNOLOGY CORPORATION

By KAH Date 3/16/90 Subject whirlpool/Amert Sheet No. 1 of 2

Chkd. By DM Date 3/23/90 Slug Test Calc. for MW-9 Proj. No. 44649301

For MW- 8



H = 10.25 ft. y_0 = 2.0

L = 9 ft. y_t = 0.14

D = 11.75 ft. t = 60 sec

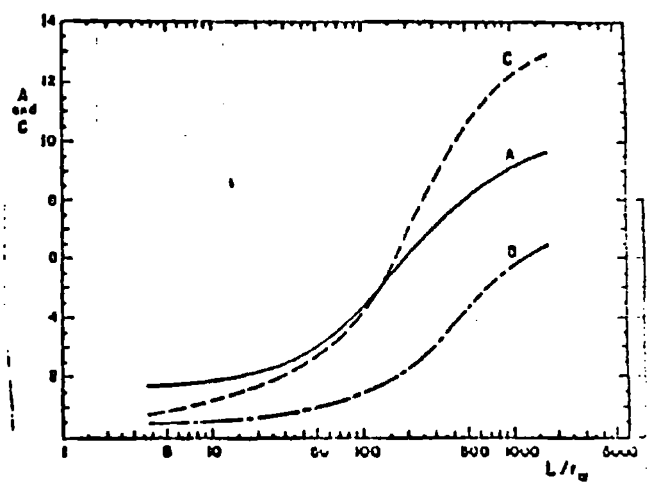
$2r_c$ = (2) .17 ft = ____ ft

$2r_w$ = (2) .42 ft. = ____ ft.

Formulas:

If D > H; then use

F1. $$\ln \frac{R_e}{r_w} = \left[\frac{1.1}{\ln (H/r_w)} + \frac{A + B \ln [(D-H)/r_w]}{L/r_w}\right]^{-1}$$



If D = H; then use

F2. $$\ln R_e/r_w = \left(\frac{1.1}{\ln (H/r_w)} + \frac{C}{L/r_w}\right)^{-1}$$

$\frac{L}{r_w}$ = 21.43

then:

A = 2.4

B = 0.75

C = ____

Solution for Hydraulic Conductivity, (K) is:

$$K = \frac{r_c^2 \ln (R_e/r_w)}{2L} \frac{1}{t} \ln \frac{y_0}{y_t}$$

K = $\frac{[\quad]}{2(\quad)}$ · ln ____ = ____

K = .0001 $\frac{FT}{sec}$ · 30.477 $\frac{cm}{FT}$ = 4.3×10^{-3} $\frac{cm}{sec}$

or ft/day

INTERNATIONAL TECHNOLOGY CORPORATION

By KAH Date 3/16/90 Subject Slug Test - MW-9 Sheet No. 2 of 2

Chkd. By ____ Date ____ Proj. No. 446493.01

$D > H$

$\therefore$

$$\ln R_e/r_w = \left[\frac{1.1}{\ln(H/r_w)} + \frac{A + B \ln\left(D-H/r_w\right)}{L/r_w} \right]^{-1}$$

$$= \left[\frac{1.1}{3.195} + \frac{(2.4) + (.75)(1.27)}{21.43} \right]^{-1}$$

$L/r_w = 21.43$

$A = 2.4$

$B = 0.75$

$$= (.3443) + (.1564)^{-1}$$

$$\ln R_e/r_w = 1.997$$

$$K = \frac{r_c^{\,2}(\ln R_e/r_w)}{2L} \quad \frac{1}{t} \ln y_0/y_t$$

$$\left(\frac{(0.0289)(1.997)}{18} \right) \left(\frac{2.659}{60} \right)$$

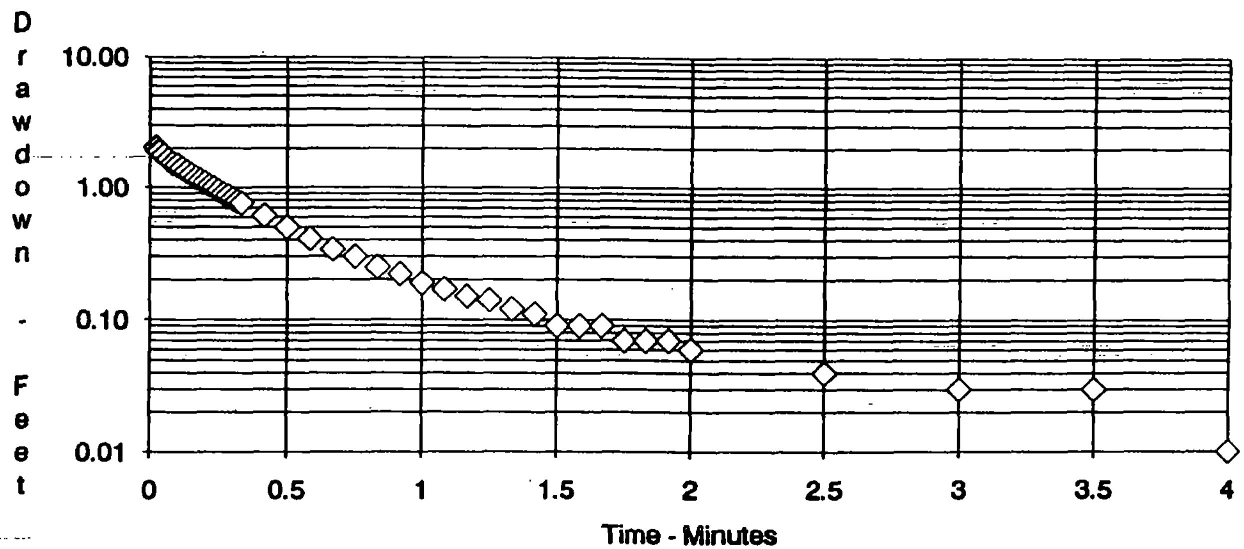
$$= (.0032)(.0443)$$

$$.0001 \text{ ft/sec} \times 30.479 \text{ cm/ft}$$

$$= 4.3 \times 10^{-3} \text{ cm/sec}$$

Do Not Scale This Drawing

DRAWN BY	STF	CHECKED BY	JJB	11-12-90	DRAWING NUMBER	446493-A86
	3/27/90	APPROVED BY	JJB	11-12-90		



SLUG TEST PLOT
MW-9
AMERT SITE INVESTIGATION
PREPARED FOR
WHIRLPOOL CORPORATION
CLYDE, OHIO

For MW-10

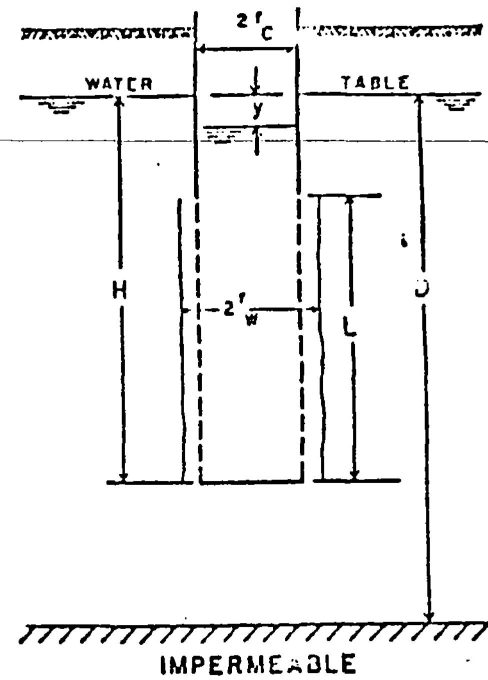
$H =$ 8.48 ft. $y_0 =$ 2.5

$L =$ 9 ft. $y_t =$ 0.35

$D =$ 10.78 ft. $t =$ 60 sec

$2r_c = (2)$ .27 ft. = ___ ft.

$2r_w = (2)$ .42 ft. = ___ ft.



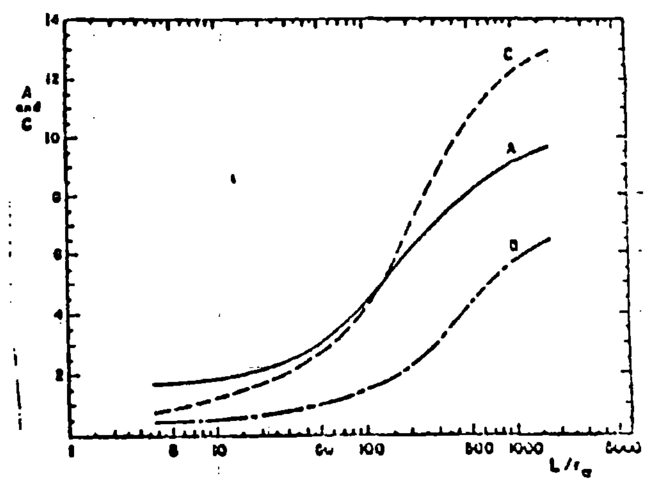
Formulas:

If D > H; then use

F1. $\ln \frac{R_e}{r_w} = \left[\frac{1.1}{\ln (H/r_w)} + \frac{A + B \ln [(D-H)/r_w]}{L/r_w}\right]^{-1}$

If D = H; then use

F2. $\ln R_e/r_w = \left(\frac{1.1}{\ln (H/r_w)} + \frac{C}{L/r_w}\right)^{-1}$



$L/r_w =$ 21.43

then:

$A =$ 2.3

$B =$ 0.7

$C =$ ___

Solution for Hydraulic Conductivity, (K) is:

$$K = \frac{r_c^2 \ln (R_e/r_w)}{2L} \frac{1}{t} \ln \frac{y_0}{y_t}$$

$K = \frac{[\quad]}{2(\quad)} \cdot \ln$ ___ = ___

$K =$ .0003 $\frac{FT}{sec} \cdot 30.477 \frac{cm}{FT} =$ 7.7×10^{-3} $\frac{cm}{sec}$

or ft/day

INTERNATIONAL TECHNOLOGY CORPORATION

By KAH Date 3/16/90 Subject Slug Test – MW-10 Sheet No. 2 of 2

Chkd. By ____ Date ____ Proj. No. 446493.01

D > H

$$\therefore \ln R_e/r_w = \left[\frac{1.1}{\ln(H/r_w)} + \frac{A + B\ln\left(\frac{D-H}{r_w}\right)}{L/r_w} \right]^{-1}$$

$$L/r_w = 21.43$$

$$A = 2.3$$

$$B = 0.7$$

$$\left[\frac{1.1}{3.005} + \frac{(2.3) + (.7)(1.700)}{21.43} \right]^{-1}$$

$$\left[(.3661) + (.1629) \right]^{-1}$$

$$\ln Re/r_w = 1.89$$

$$K = \frac{r_c^2 \left(\ln Re/r_w\right)}{2L} \frac{1}{t} \ln Y_0/Y_t$$

$$= \frac{(.27)^2 (1.89)}{18} (.0328)$$

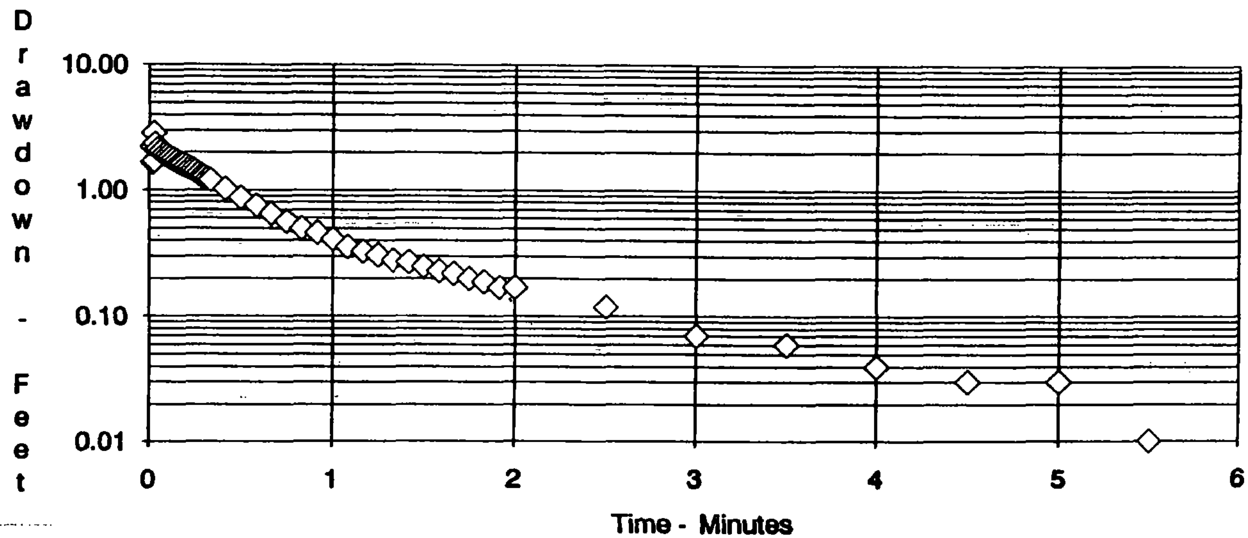
$$= (.0077)(.0328)$$

$$= .0003 \text{ ft/sec} \times 30.479 \text{ cm/ft}$$

$$= 7.7 \times 10^{-3} \text{ cm/sec}$$

Do Not Scale This Drawing

DRAWN BY	STF 3/27/90	CHECKED BY	VMB	11-12-90	DRAWING NUMBER	446493-A87
		APPROVED BY	VMB	11-12-90		



SLUG TEST PLOT
MW-10
AMERT SITE INVESTIGATION
PREPARED FOR
WHIRLPOOL CORPORATION
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INTERNATIONAL TECHNOLOGY CORPORATION

By KAH Date 3/16/90 Subject Whirlpool/Amert Sheet No. 1 of 2
Chkd. By DM Date 3/23/90 Slug Test Calc. for MW-4 Proj. No. 446493.01

For MW- 4

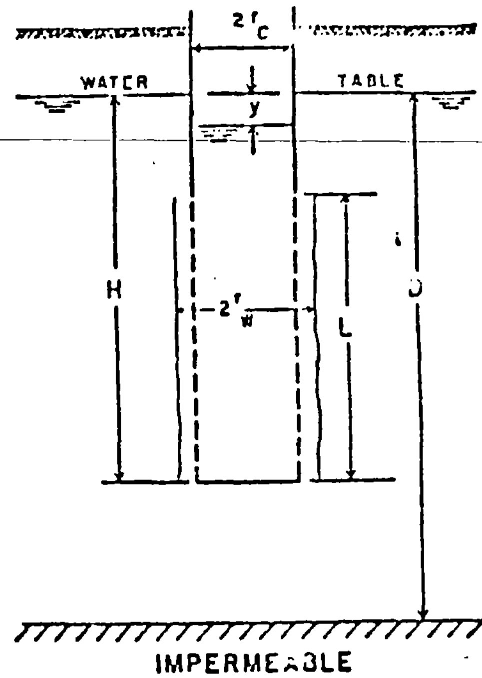
$H =$ 9.66 ft. $y_0 =$ 2.2

$L =$ 4 ft. $y_t =$ 0.6

$D =$ 11.56 ft. $t =$ 240 sec

$2r_c = (2)$ .17 ft $=$ ____ ft

$2r_w = (2)$ .42 ft $=$ ____ ft



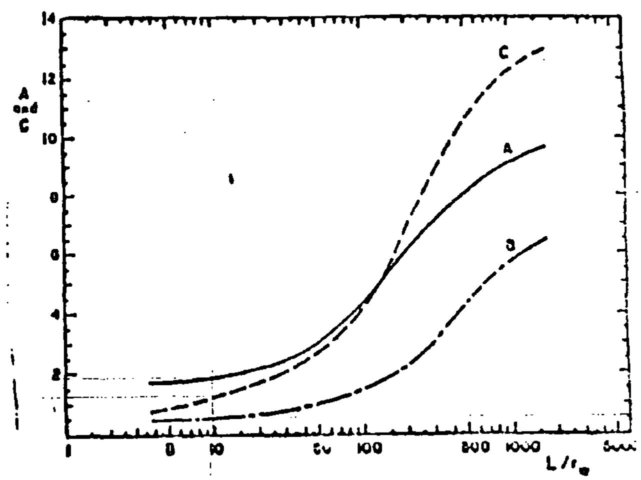
Formulas:

If D > H; then use

F1. $$\ln \frac{R_e}{r_w} = \left[\frac{1.1}{\ln (H/r_w)} + \frac{A + B \ln [(D-H)/r_w]}{L/r_w}\right]^{-1}$$

If D = H; then use

F2. $$\ln R_e/r_w = \left(\frac{1.1}{\ln (H/r_w)} + \frac{C}{L/r_w}\right)^{-1}$$



$L/r_w =$ 9.52

then:

$A =$ 1.8

$B =$ .5

$C =$ 1.25

Solution for Hydraulic Conductivity, (K) is:

$$K = \frac{r_c^2 \ln (R_e/r_w)}{2L} \frac{1}{t} \ln \frac{y_0}{y_t}$$

$K = \frac{[\quad]}{2(\quad)} \cdot \ln$ ____ $=$ ____

$K = 3.132 \times 10^{-5} \frac{ft}{sec} \cdot 30.477 \frac{cm}{ft} = 1 \times 10^{-3} \frac{cm}{sec}$

or ft/day

INTERNATIONAL TECHNOLOGY CORPORATION

By KAH Date 3/16/90 Subject Slug Test MW-4 Sheet No. 2 of 2

Chkd. By ___ Date ___ Proj. No. 446493

$D > H$

$$\therefore \ \ln \frac{R_e}{r_w} = \left[\frac{1.1}{\ln(H/r_w)} + \frac{A + B \ln\left(\frac{D-H}{r_w}\right)}{L/r_w}\right]^{-1}$$

$$L/r_w = 9.52$$

$$\ln \frac{R_e}{r_w} = \left[\frac{1.1}{3.136} + \frac{1.8 + (.5)\ln(4.52)}{9.52}\right]^{-1}$$

$$= \left[0.3508 + \frac{1.8 + (.5)(1.51)}{9.52}\right]^{-1}$$

$$= (0.3508 + 0.2684)^{-1}$$

$$= 1.615$$

$$K = \frac{r_c^2 (\ln R_e/r_w)}{2L} \frac{1}{t} \ln\left(\frac{Y_0}{Y_t}\right)$$

$$= \frac{(.17)^2 (1.615)}{8} \frac{1}{240} (1.2993)$$

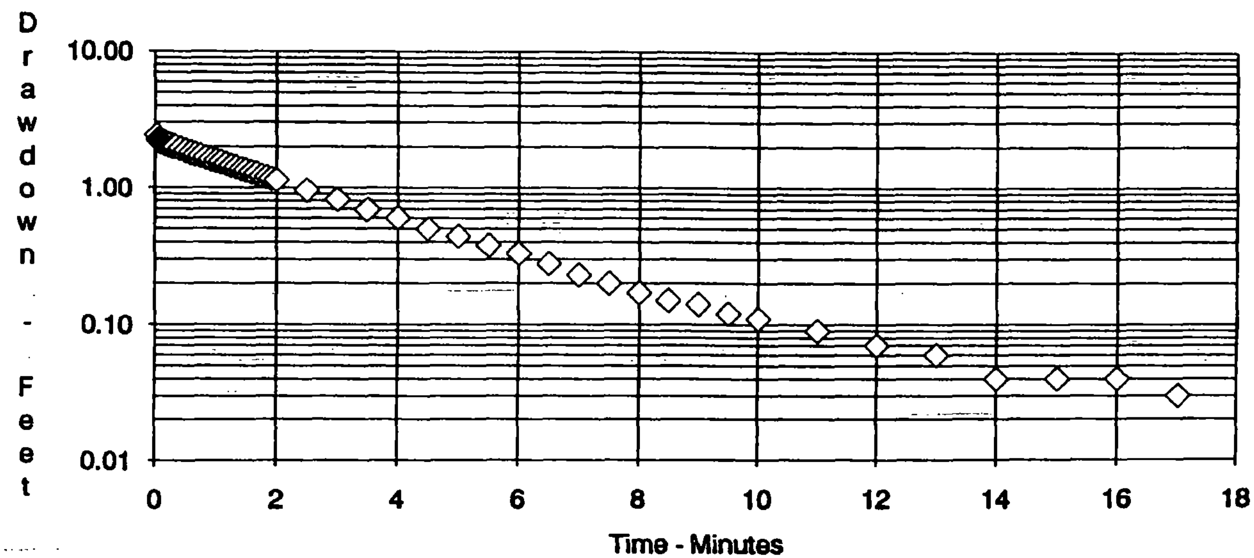
$$= (.0058)(.0054)$$

$$= 3.132 \times 10^{-5} \text{ ft/sec} \times 30.479 \text{ cm/ft}$$

$$= \underline{1 \times 10^{-3}} \text{ cm/sec}$$

Do Not Scale This Drawing

DRAWN BY	STF 3/27/90	CHECKED BY	VMS	11-12-90	DRAWING NUMBER	446493-A83
		APPROVED BY	VMS	11-12-90		



IT

SLUG TEST PLOT
MW-4
AMERT SITE INVESTIGATION
PREPARED FOR
WHIRLPOOL CORPORATION
CLYDE, OHIO

APPENDIX
C

APPENDIX C

SAMPLE COLLECTION LOGS

INTERNATIONAL TECHNOLOGY CORPORATION

DATE	1 2 0 5 8 9
TIME	1 2 1 5
PAGE 1 OF 1	
PAGE	
PROJECT NO.	446493

SAMPLE COLLECTION LOG

PROJECT NAME Whirlpool - Amert

SAMPLE NO. SS-1

SAMPLE LOCATION Amert site

SAMPLE TYPE Soil

COMPOSITE ___ YES ✓ NO

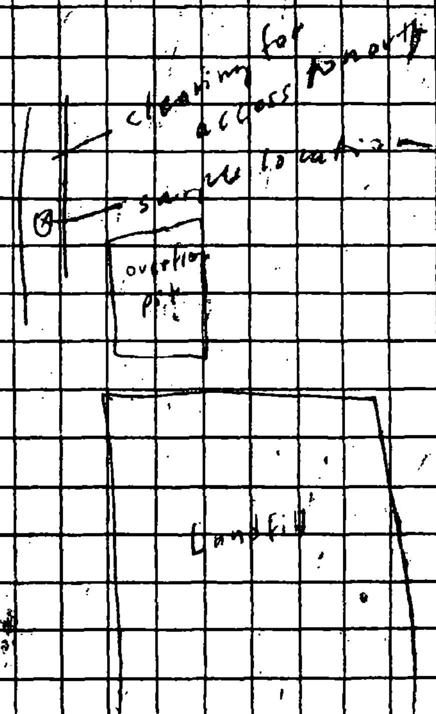
COMPOSITE TYPE N/A

DEPTH OF SAMPLE 6-12 inches

WEATHER Cloudy

CONTAINERS USED	AMOUNT COLLECTED
1 500ml	Full
1 1250 ml	Full

COMMENTS:



PREPARED BY: Beatty

INTERNATIONAL TECHNOLOGY CORPORATION

DATE	1 2 0 5 8 9
TIME	1 2 3 0
PAGE	1 OF 1
PAGE	
PROJECT NO.	

SAMPLE COLLECTION LOG

PROJECT NAME: Whirlpool - Amert

SAMPLE NO.: SS - 2

SAMPLE LOCATION: Amert Site

SAMPLE TYPE: Soil

COMPOSITE ___ YES ✓ NO

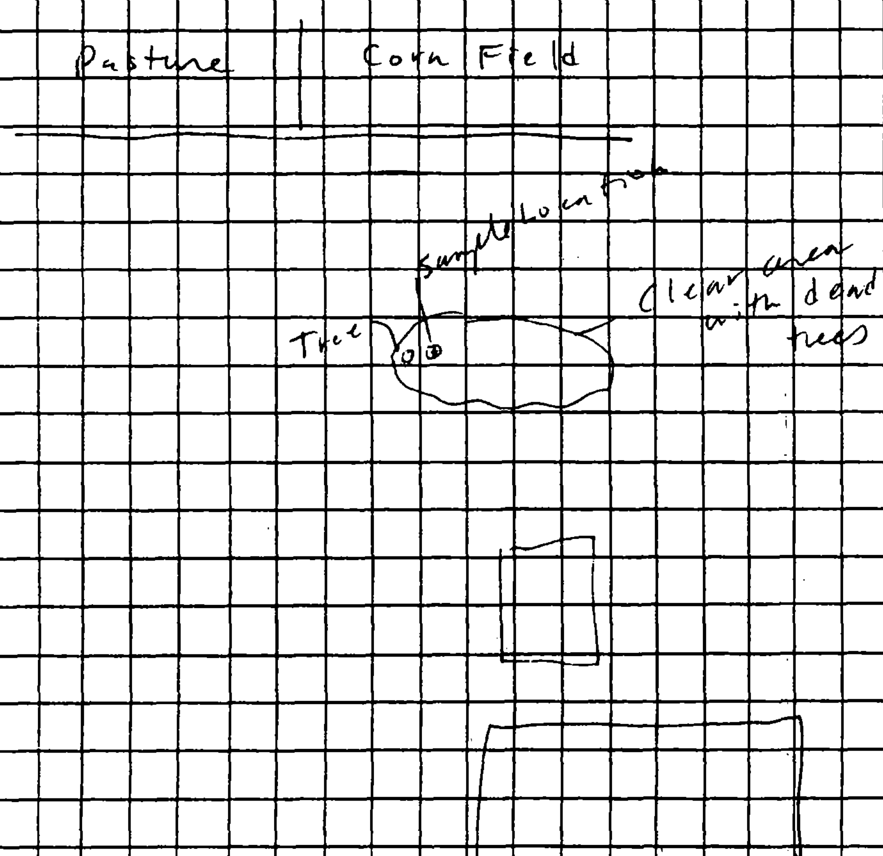
COMPOSITE TYPE: ___

DEPTH OF SAMPLE: 6 - 12 inches

WEATHER: Cloudy Cold

CONTAINERS USED	AMOUNT COLLECTED
1 500 ml	Full
1 125 ml	Full

COMMENTS:



PREPARED BY: M. Bentley

INTERNATIONAL TECHNOLOGY CORPORATION

DATE	1 2 0 5 8 9
TIME	1 2 4 0
PAGE	1 OF 1
PAGE	
PROJECT NO.	446493.01

SAMPLE COLLECTION LOG

PROJECT NAME Whirlpool /Amert

SAMPLE NO. SS-3

SAMPLE LOCATION Amert

SAMPLE TYPE Soil

COMPOSITE ___ YES ✓ NO

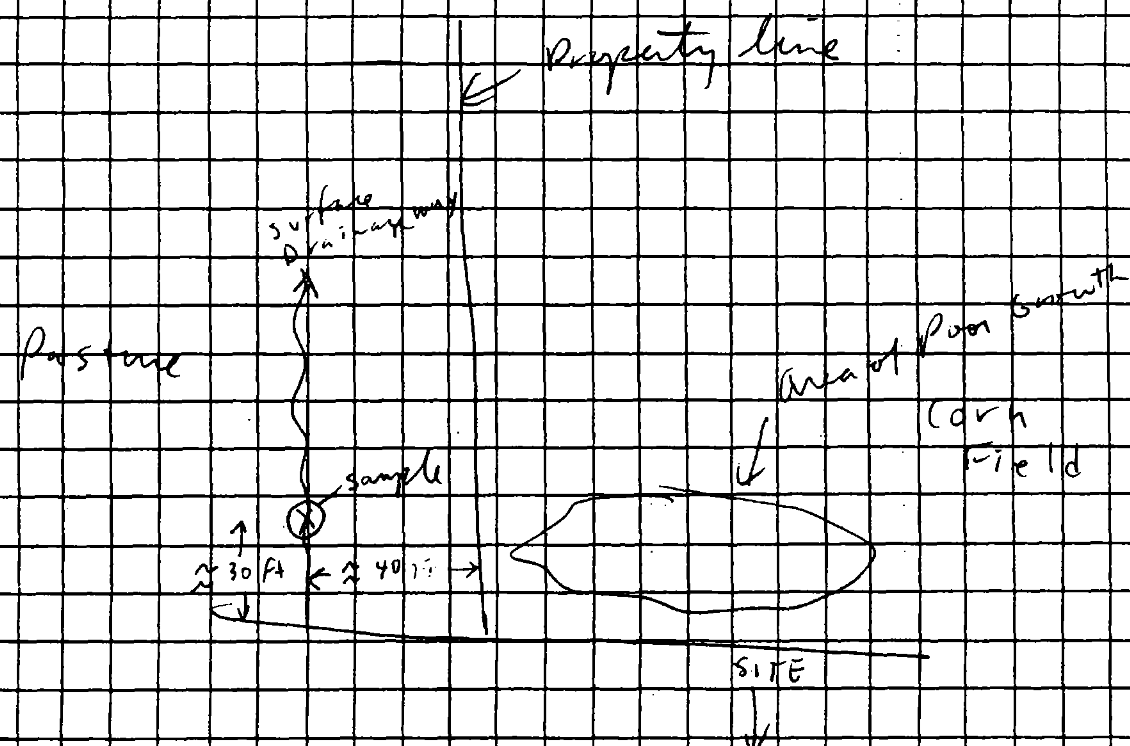
COMPOSITE TYPE ~~[illegible]~~

DEPTH OF SAMPLE 6-12"

WEATHER Cloudy Cold

CONTAINERS USED	AMOUNT COLLECTED
500 ml	Full
125 ml	Full

COMMENTS:



PREPARED BY: M. Bentley

INTERNATIONAL TECHNOLOGY CORPORATION

DATE	12 05 89
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PROJECT NO.	446493.01

SAMPLE COLLECTION LOG

PROJECT NAME Whirlpool Amert

SAMPLE NO. SS4

SAMPLE LOCATION Amert

SAMPLE TYPE Soil

COMPOSITE ____ YES X NO

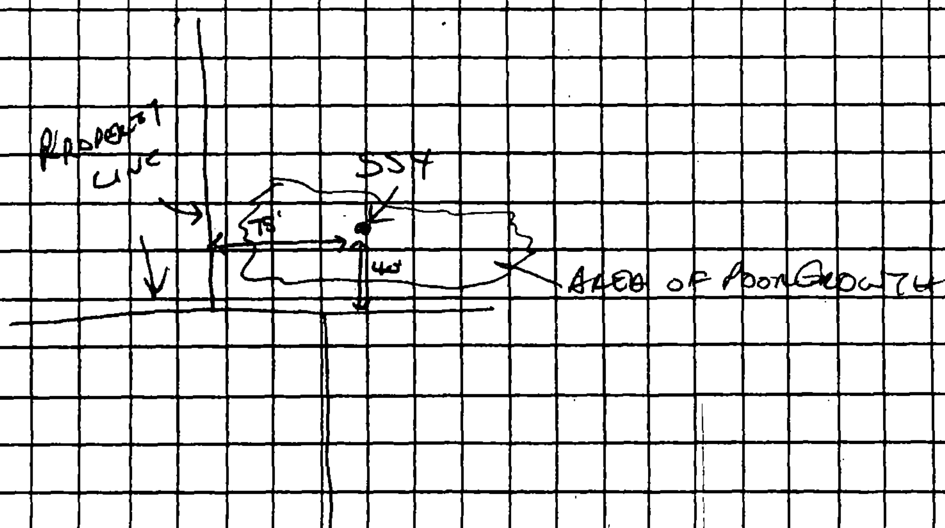
COMPOSITE TYPE ____

DEPTH OF SAMPLE 6"-12"

WEATHER Cloudy Cold

CONTAINERS USED	AMOUNT COLLECTED
500 ml	Full
125 ml	Full

COMMENTS:



PREPARED BY: L. Garrett

INTERNATIONAL TECHNOLOGY CORPORATION

DATE	1 2 0 5 8 9
TIME	1 3 3 0
PAGE	1 OF 1
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PROJECT NO.	446493.01

SAMPLE COLLECTION LOG

PROJECT NAME WHIRLPOOL AMORY

SAMPLE NO. SS5

SAMPLE LOCATION

SAMPLE TYPE SOIL

COMPOSITE ____ YES __X__ NO

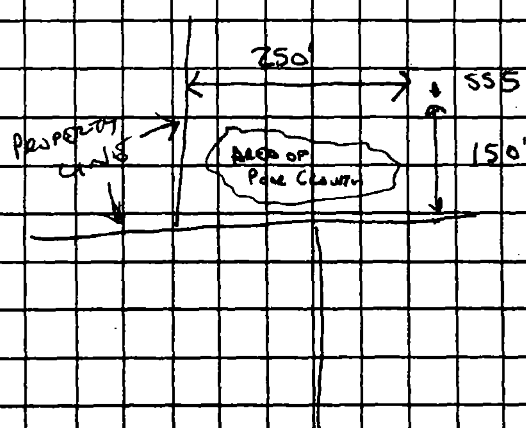
COMPOSITE TYPE

DEPTH OF SAMPLE 6"-12"

WEATHER CLOUDY COLD

CONTAINERS USED	AMOUNT COLLECTED
500 ml	FULL
125 ml	FULL

COMMENTS:



PREPARED BY: LEE GARRETT

INTERNATIONAL TECHNOLOGY CORPORATION

DATE	04 24 90
TIME	11 20
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PAGE	
PROJECT NO.	4464.3

SAMPLE COLLECTION LOG

PROJECT NAME: Whirlpool/Arnet

SAMPLE NO.: SS-6, SS 6-A (grain size analysis)

SAMPLE LOCATION: Arnet

SAMPLE TYPE: Soil - Silty Fine Sand, Moist

COMPOSITE ___ YES ✓ NO

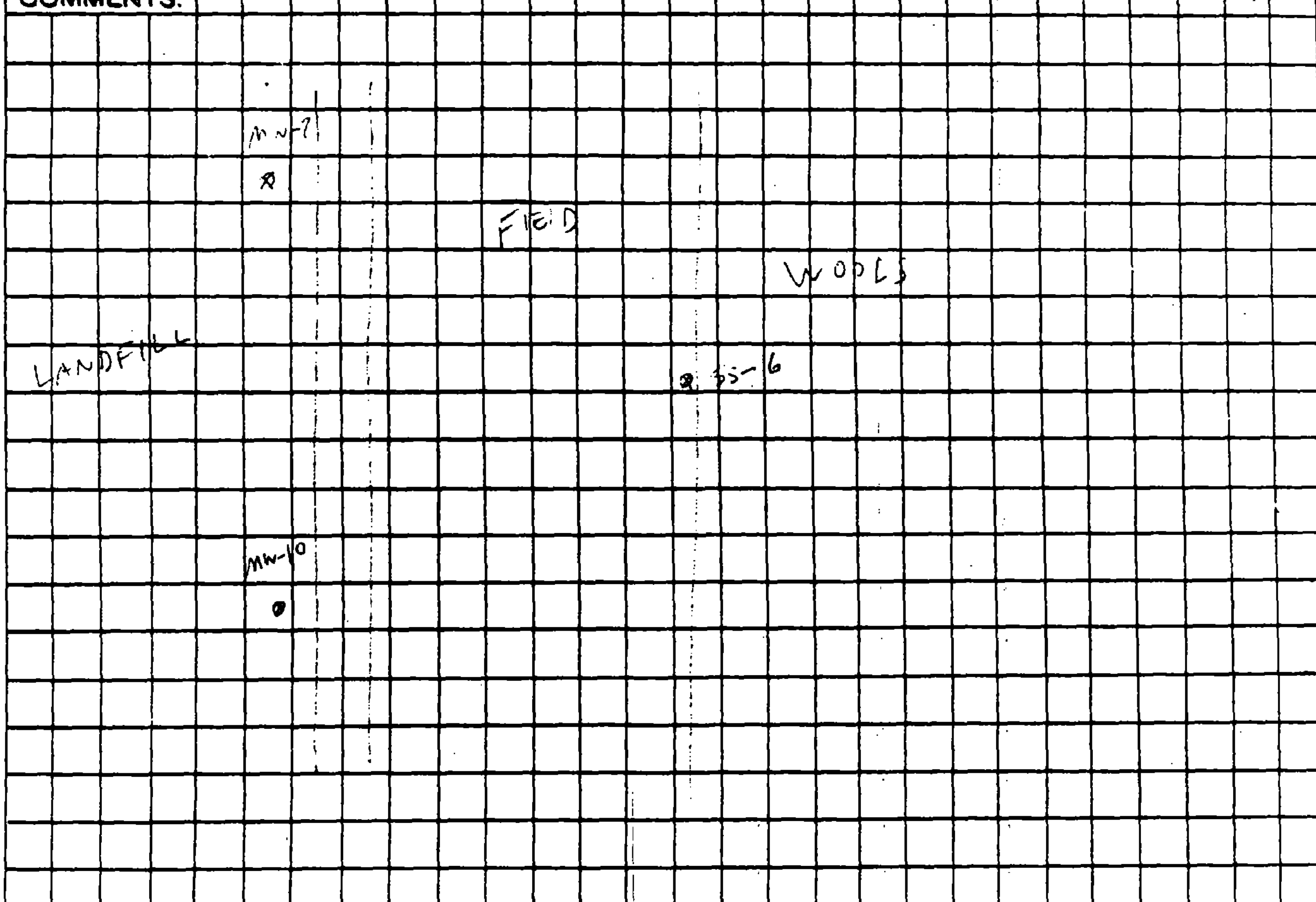
COMPOSITE TYPE: n/A

DEPTH OF SAMPLE: 6-12 inches

WEATHER: P. Cloudy, Warm

CONTAINERS USED	AMOUNT COLLECTED
2-250 ml glass	Full

COMMENTS:



PREPARED BY: [illegible]

INTERNATIONAL TECHNOLOGY CORPORATION

DATE	0 4 2 4 9 0
TIME	1 1 4 5
PAGE ___ OF ___	
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PROJECT NO.	446493

SAMPLE COLLECTION LOG

PROJECT NAME Whirlpool/Amert

SAMPLE NO. SS-7

SAMPLE LOCATION Amert, Drainageway

SAMPLE TYPE Soil

COMPOSITE ___ YES ✓ NO

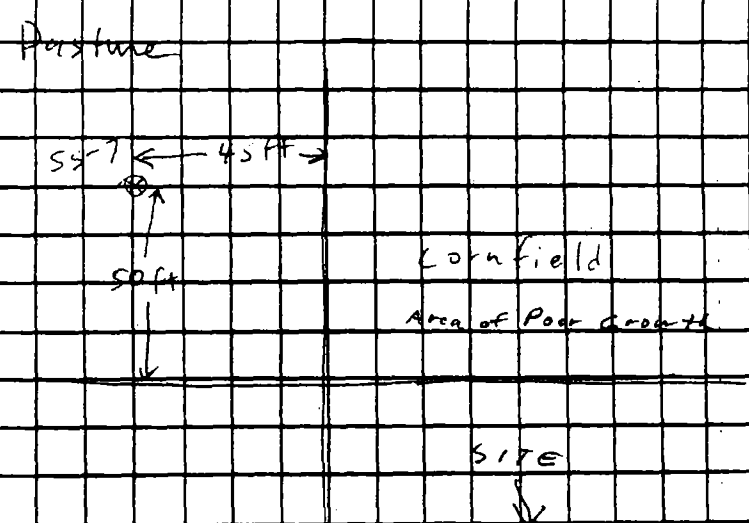
COMPOSITE TYPE N/A

DEPTH OF SAMPLE 6-12 in

WEATHER P. Cloudy Warm

CONTAINERS USED	AMOUNT COLLECTED
1 - 250 ml glass	Full

COMMENTS: Sample Location Appears to Be Recently Seeded
Surface Soil - Dark Brown, Changes to Light Brown at 6" Depth
Sampled Light Brown Material



PREPARED BY: Bentley

IT INTERNATIONAL TECHNOLOGY CORPORATION

DATE	0	4	2	4	9	0
TIME	1	2	1	0		
PAGE ___ OF ___						
PAGE						
PROJECT NO. 446493						

SAMPLE COLLECTION LOG

PROJECT NAME Whirlpool/Amert

SAMPLE NO. SS-8,

SAMPLE LOCATION Amert North of Landfill

SAMPLE TYPE Soil

COMPOSITE ___ YES ✓ NO

COMPOSITE TYPE N/A

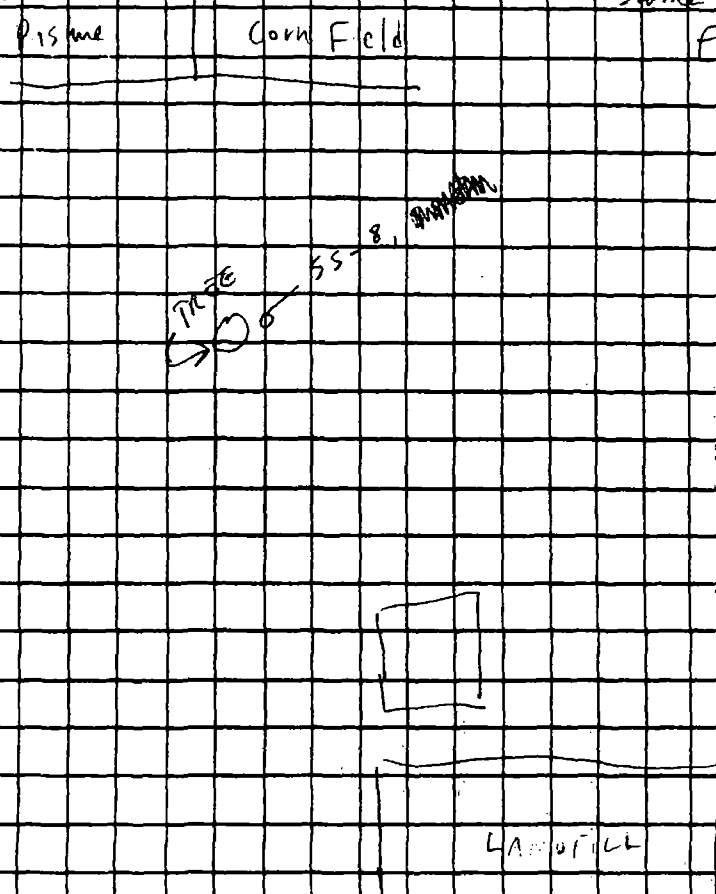
DEPTH OF SAMPLE 6-12 in

WEATHER P. Cloudy, Warm

CONTAINERS USED	AMOUNT COLLECTED
1-250 ml glass	Full

COMMENTS:

Same location (5 ft away) From SS-2



PREPARED BY: MB

INTERNATIONAL TECHNOLOGY CORPORATION

DATE	0 4 2 4 9 6
TIME	1 3 4 5
PAGE	1 OF ____
PAGE	
PROJECT NO.	446493

SAMPLE COLLECTION LOG

PROJECT NAME Whirlpool/Amcast

SAMPLE NO. SS-9

SAMPLE LOCATION Amcast

SAMPLE TYPE Soil

COMPOSITE ____ YES ✓ NO

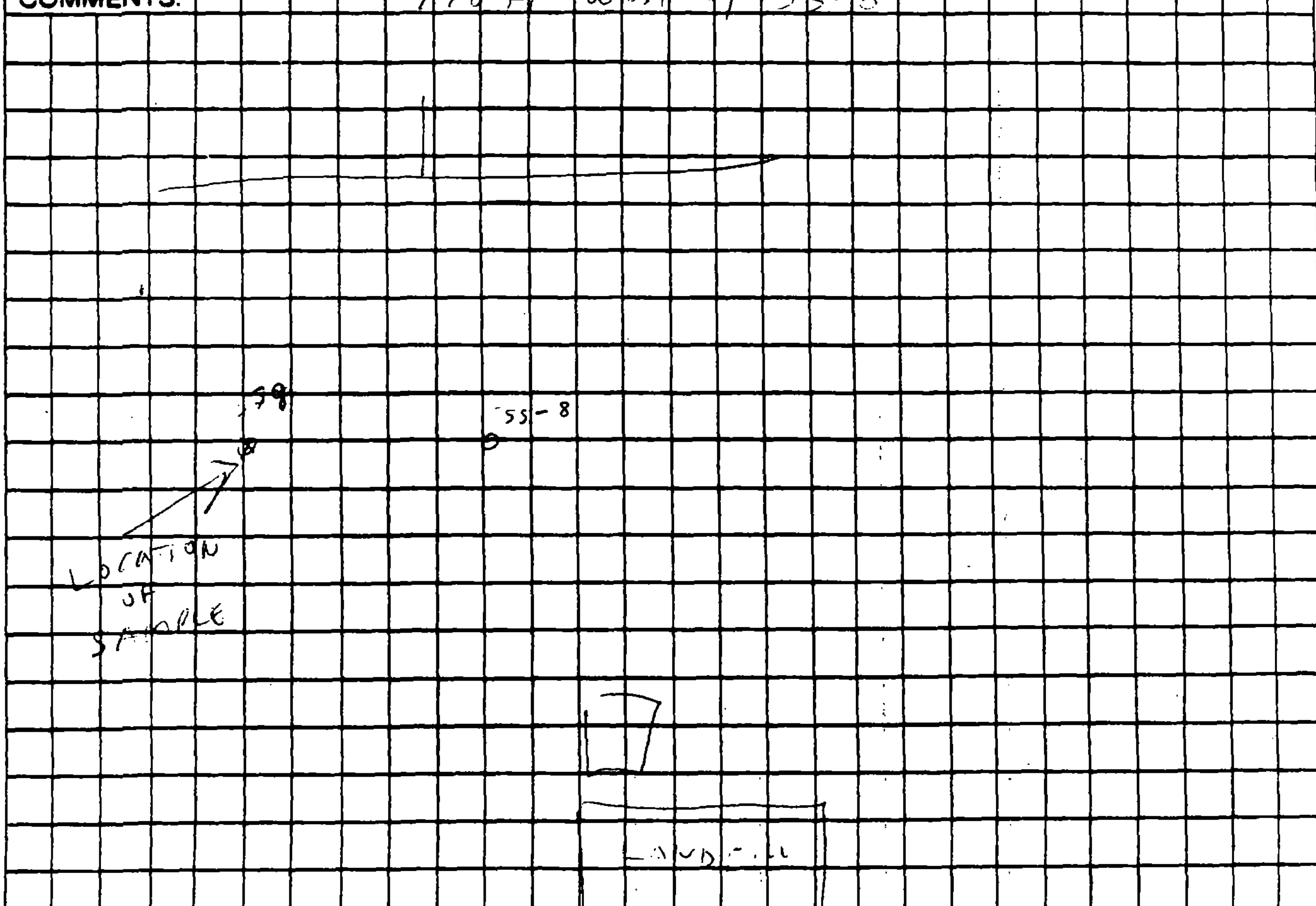
COMPOSITE TYPE N/A

DEPTH OF SAMPLE 6-12 in

WEATHER P. Cloudy - Warm

CONTAINERS USED	AMOUNT COLLECTED
1-250 ml glass	Full

COMMENTS: 140 ft west of SS-8



PREPARED BY: MBeatty

INTERNATIONAL TECHNOLOGY CORPORATION

DATE	0 4 2 4 9 0
TIME	1 4 0 0
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PROJECT NO.	446493

SAMPLE COLLECTION LOG

PROJECT NAME: Whirlpool / Amert

SAMPLE NO.: SS-10, SS-11, SS-12, SS-10A

SAMPLE LOCATION: Amert - Cornfield - "Background" All from Same Location

SAMPLE TYPE: Soil

COMPOSITE ___ YES ✓ NO

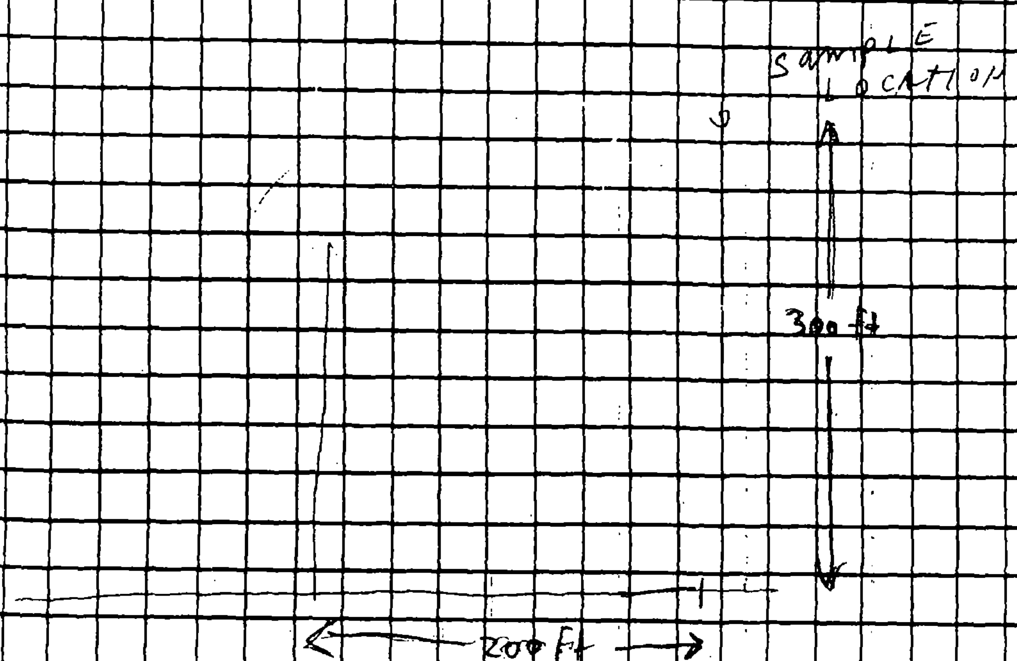
COMPOSITE TYPE: N/A

DEPTH OF SAMPLE: SS-10A; SS-10: 6-12 in | SS-11: 12-18 in | SS-12: 18-24 in

WEATHER: P. Cloudy Warm

CONTAINERS USED	AMOUNT COLLECTED
4 - 250 ml glass	Full

COMMENTS: Some Free water at 18 inches



PREPARED BY: M Bentley

INTERNATIONAL TECHNOLOGY CORPORATION

DATE	0 4 2 4 9 0
TIME	1 4 4 0
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PAGE	
PROJECT NO.	446493

SAMPLE COLLECTION LOG

PROJECT NAME Whirlpool /Amert

SAMPLE NO. SS-13, SS-14, SS-15, SS-14A

SAMPLE LOCATION Amert cornfield "Bare Spot"

SAMPLE TYPE Soil

COMPOSITE ___ YES ✓ NO

COMPOSITE TYPE N/A

DEPTH OF SAMPLE SS-13; 6-12 in | SS-14A: SS-14: 12-18 in | SS-15: 18-24 in

WEATHER P. Cloudy Warm

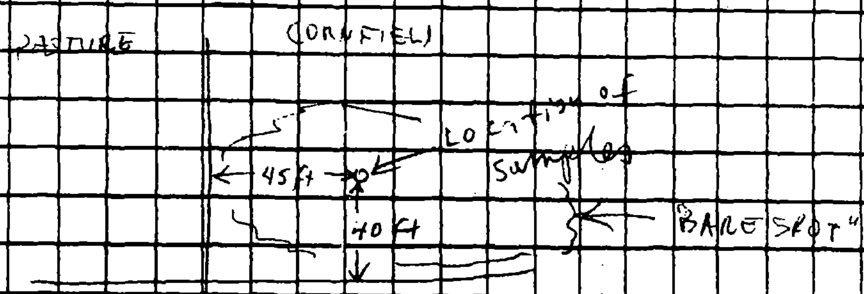
CONTAINERS USED	AMOUNT COLLECTED
4 (3) - 250 ml glass	Full

COMMENTS:

Brown Sandy clay 0-8" (SS-13)

Tan Fine Sand 8-18" (SS-14)

Gray sandy clay below 18" (SS-15) Moist, no free water observed



PREPARED BY: M Bentley

INTERNATIONAL TECHNOLOGY CORPORATION

DATE	04 24 90
TIME	1510
PAGE ___ OF ___	
PAGE	
PROJECT NO.	44[illegible]493

SAMPLE COLLECTION LOG

PROJECT NAME Whirlpool / Amert

SAMPLE NO. SS-16

SAMPLE LOCATION East Discharge Area - "Background

SAMPLE TYPE Soil

COMPOSITE ___ YES ✓ NO

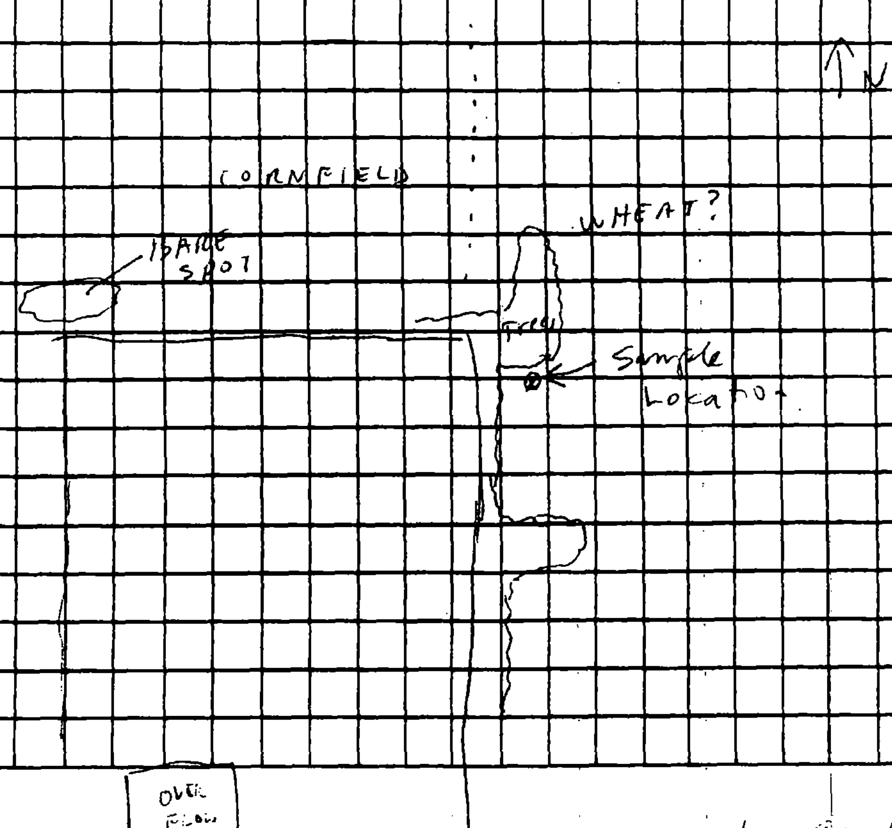
COMPOSITE TYPE N/A

DEPTH OF SAMPLE 6-12 in

WEATHER P. Cloudy Warm

CONTAINERS USED	AMOUNT COLLECTED
1 - 250 ml	Full

COMMENTS:



PREPARED BY:

INTERNATIONAL TECHNOLOGY CORPORATION

DATE	9	4	2	4	9	0
TIME	1	5	3	0		
PAGE ___ OF ___						
PAGE						
PROJECT NO. 446493						

SAMPLE COLLECTION LOG

PROJECT NAME: Whirlpool Amana

SAMPLE NO.: SS-17

SAMPLE LOCATION: West Discharge Area – "Background"

SAMPLE TYPE: Soil

COMPOSITE ___ YES ✓ NO

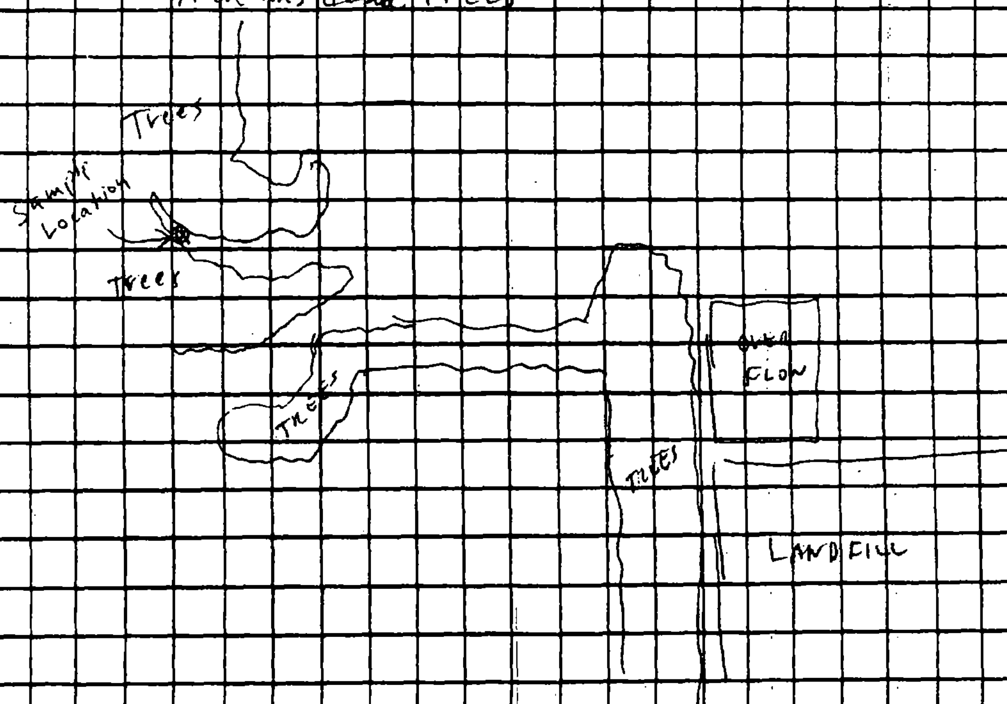
COMPOSITE TYPE: N/A

DEPTH OF SAMPLE: 12 in

WEATHER: P. Cloudy Warm

CONTAINERS USED	AMOUNT COLLECTED
1 - 150 ml Glass	Full

COMMENTS: Area has Standing water
Sample is wet
Area has dead trees



PREPARED BY: M Bentley

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DATE	1	2	0	6	8	9
TIME						
PAGE 1 OF 1						
PAGE						
PROJECT NO. 446493.01						

SAMPLE COLLECTION LOG

PROJECT NAME Whirlpool Amert Site

SAMPLE NO. SW-1

SAMPLE LOCATION Amert

SAMPLE TYPE Surface Water

COMPOSITE ____ YES ✓ NO

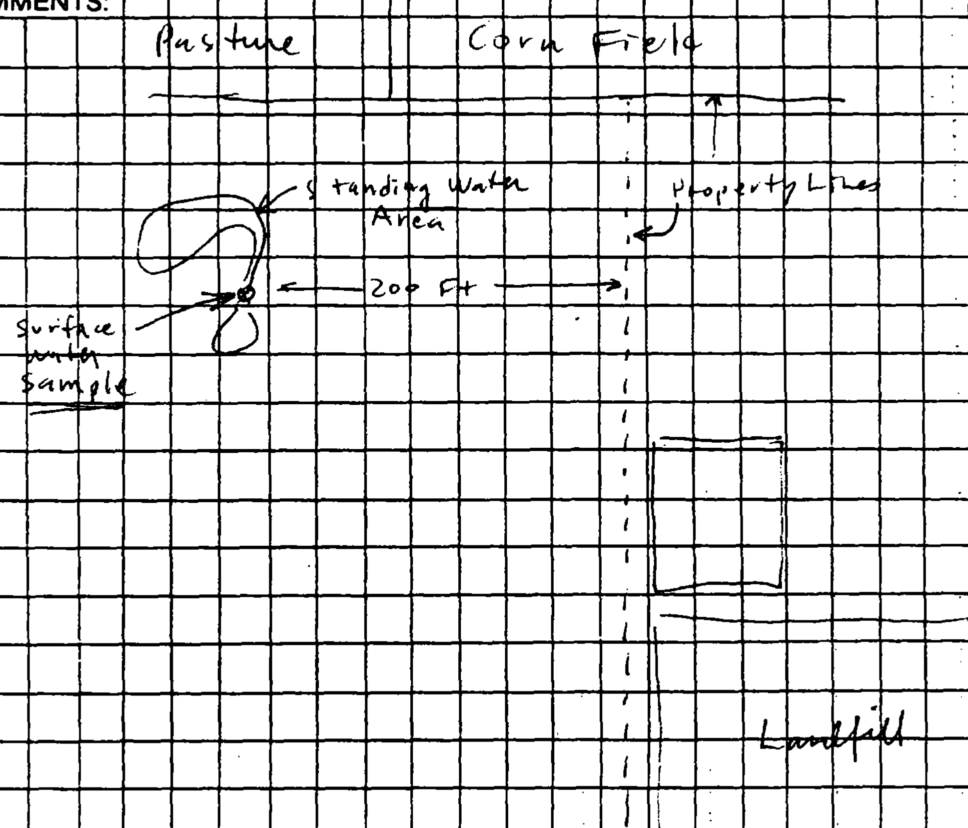
COMPOSITE TYPE —

DEPTH OF SAMPLE —

WEATHER Cold, Cloudy

CONTAINERS USED	AMOUNT COLLECTED
2-40ml vial	Full
1 1l poly	"
1 500ml poly	"
1 250ml ~~poly~~ glass	"

COMMENTS:



PREPARED BY: M Bentley

INTERNATIONAL TECHNOLOGY CORPORATION

DATE	0	4	2	4	9	0
TIME	1	7	4	0		
PAGE ___ OF ___						
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PROJECT NO. 446493						

SAMPLE COLLECTION LOG

PROJECT NAME Whirlpool / Amert

SAMPLE NO. SW-2

SAMPLE LOCATION Amert Drain Outlet ?

SAMPLE TYPE Surface Water

COMPOSITE ___ YES ✓ NO

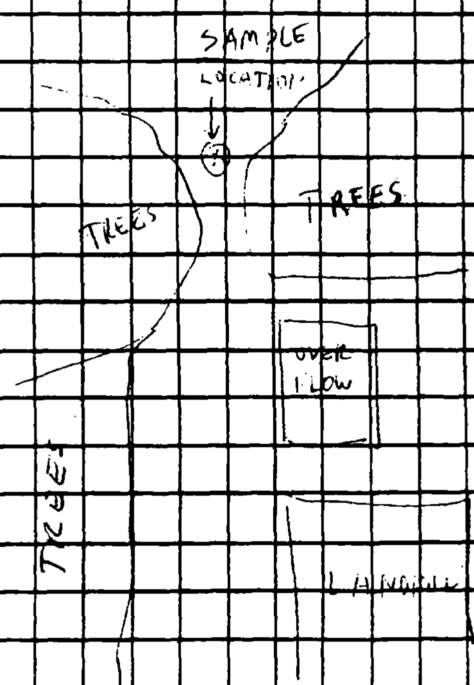
COMPOSITE TYPE N/A

DEPTH OF SAMPLE N/A

WEATHER P. Cloudy Warm

CONTAINERS USED	AMOUNT COLLECTED
2 - 1 L Plastic	Full
1 - 500mL Plastic	"
1 - 1 L Glass	"
1 - 250 mL Glass	"

COMMENTS: 30 FT North of Survey Point 21



PREPARED BY: M Bradley

INTERNATIONAL TECHNOLOGY CORPORATION

DATE	0	4	2	4	9	2
TIME	1	8	0	0		
PAGE ___ OF ___						
PAGE						
PROJECT NO.	4N693					

SAMPLE COLLECTION LOG

PROJECT NAME Whirlpool / Amcert

SAMPLE NO. SW-3

SAMPLE LOCATION (See SOIL SAMPLE SS-17 - Same Location)

SAMPLE TYPE Surface Water

COMPOSITE ___ YES ✓ NO

COMPOSITE TYPE N/A

DEPTH OF SAMPLE Surface

WEATHER P. Cloudy - Warm

CONTAINERS USED	AMOUNT COLLECTED
2 - 1 L poly	Full
1 - 1 L glass	"
1 - 500 mL poly	"
1 - 250 mL glass	"

COMMENTS: Water Not Flowing

(SAME LOCATION AS SS-17)

PREPARED BY: M. Bentley

INTERNATIONAL TECHNOLOGY CORPORATION

DATE	0 8 1 1 9 0
TIME	1 2 3 0
PAGE	1 OF 1
PAGE	
PROJECT NO.	446493

SAMPLE COLLECTION LOG

PROJECT NAME Whirlpool Amert

SAMPLE NO. SS-6 (Resample)

SAMPLE LOCATION Amert

SAMPLE TYPE Soil

COMPOSITE ___ YES ✓ NO

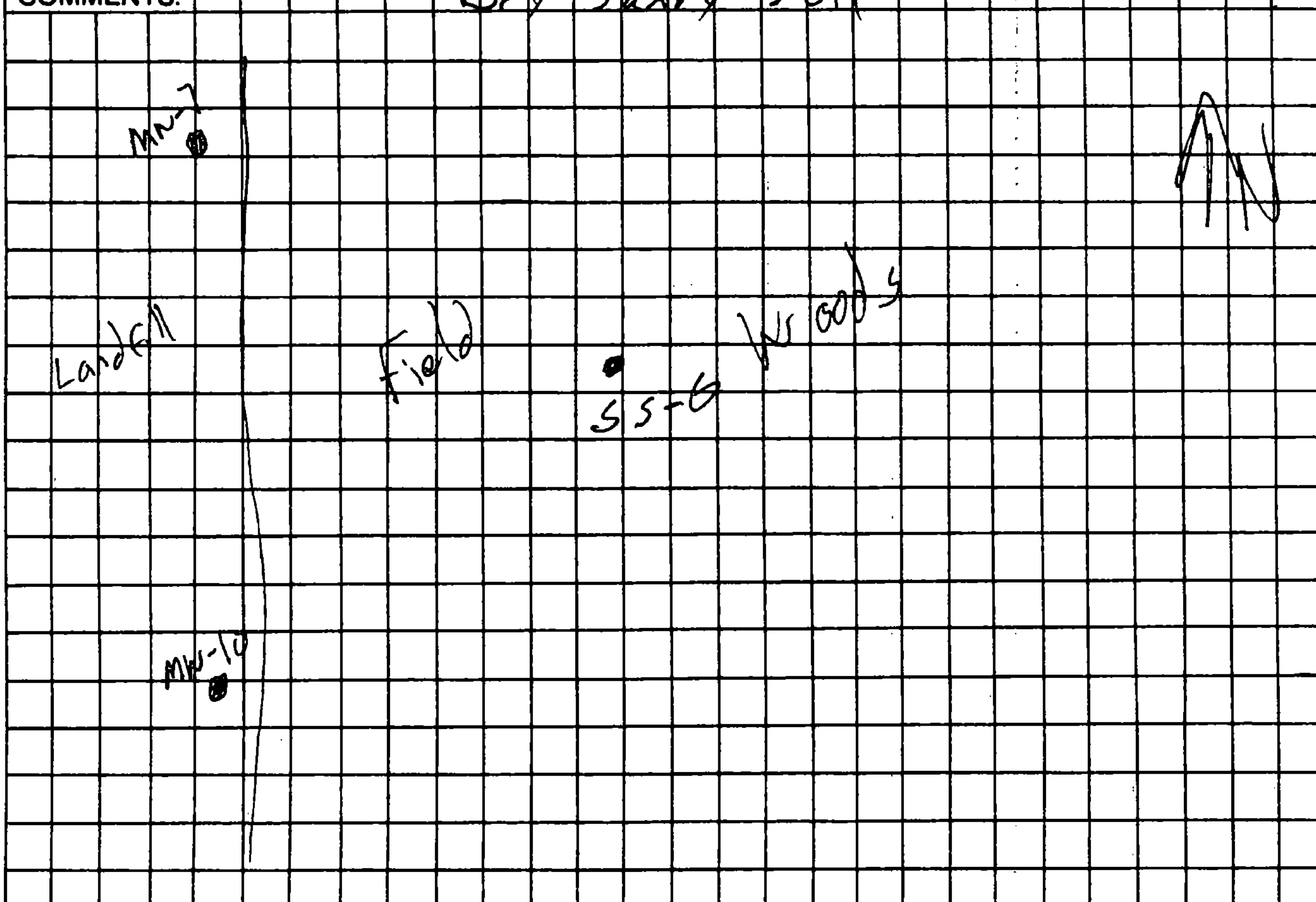
COMPOSITE TYPE —

DEPTH OF SAMPLE 6-12 inches

WEATHER ptly cloudy warm

CONTAINERS USED	AMOUNT COLLECTED
250ml	full

COMMENTS: Dry Sandy Soil



PREPARED BY: Jim Brau

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DATE	08 11 90
TIME	1 4 5 5
PAGE	1 OF 1
PAGE	
PROJECT NO.	446493

SAMPLE COLLECTION LOG

PROJECT NAME Whirlpool Amert

SAMPLE NO. SS-7 (Resample)

SAMPLE LOCATION Amert Drainageway

SAMPLE TYPE soil

COMPOSITE ____ YES ✓ NO

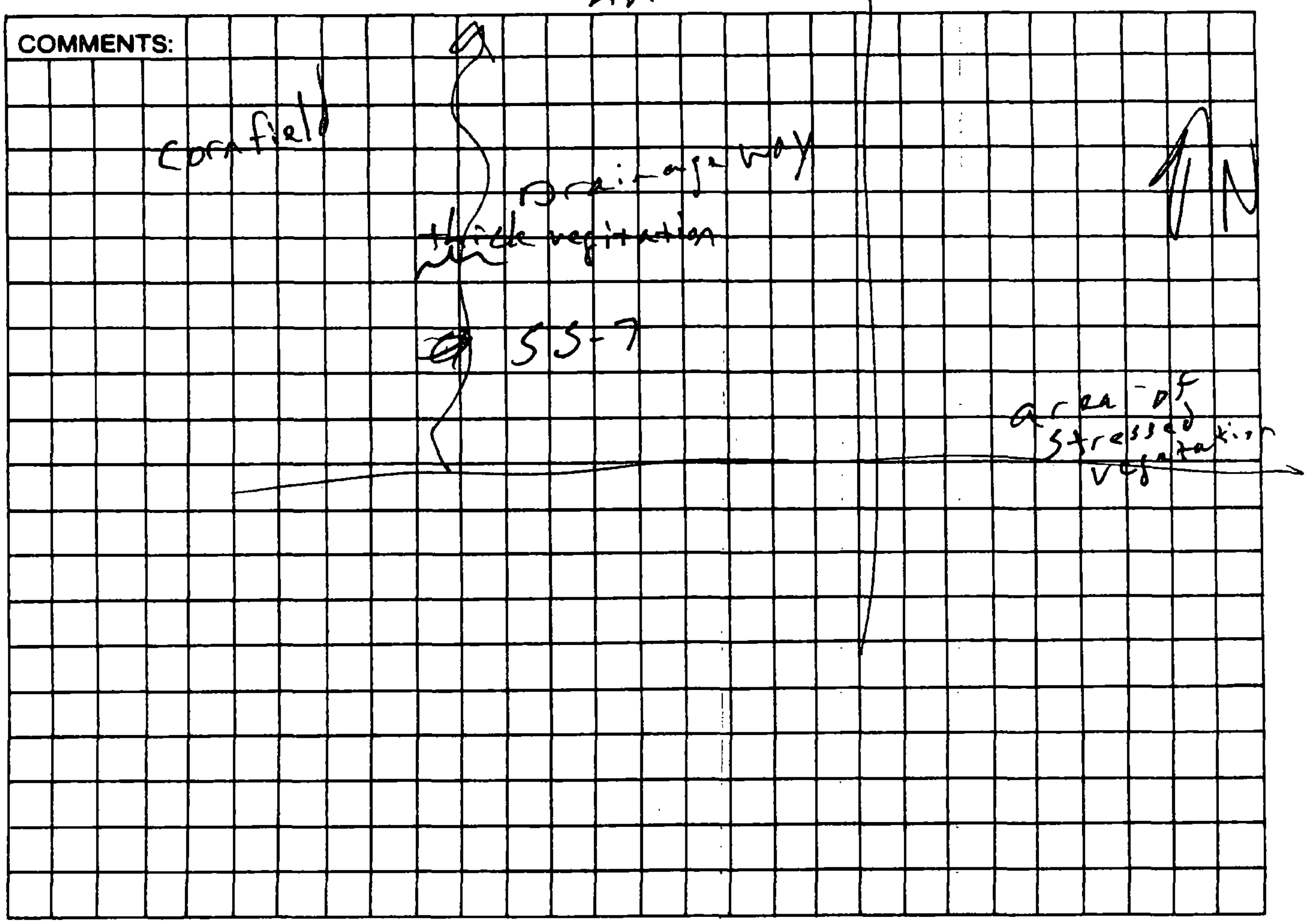
COMPOSITE TYPE ____

DEPTH OF SAMPLE 6-12 in

WEATHER Ptly cloudy ~~warm~~ hot

CONTAINERS USED	AMOUNT COLLECTED
250ml	full

COMMENTS:



PREPARED BY: Jim Brace

INTERNATIONAL TECHNOLOGY CORPORATION

DATE	0 8 1 1 9 0
TIME	1 3 1 5
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PROJECT NO.	446493

SAMPLE COLLECTION LOG

PROJECT NAME: Whirlpool Amert

SAMPLE NO.: Ss-8 (Resample)

SAMPLE LOCATION: Amert North of land fill

SAMPLE TYPE: soil

COMPOSITE ___ YES ✓ NO

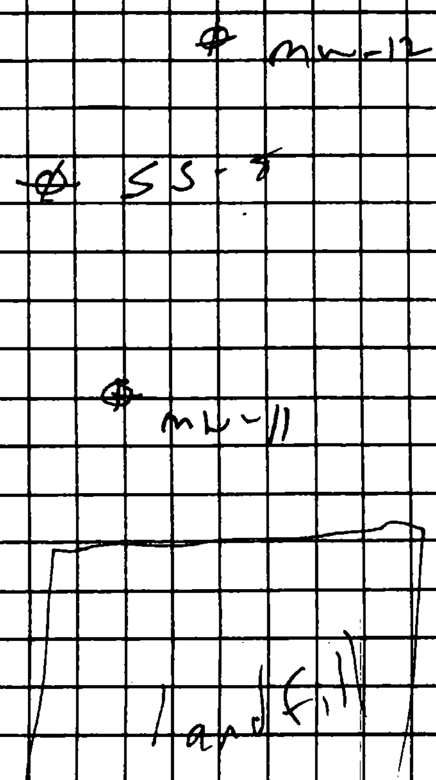
COMPOSITE TYPE: ___

DEPTH OF SAMPLE: 6-12"

WEATHER: ___

CONTAINERS USED	AMOUNT COLLECTED
250ml	full

COMMENTS: moist clayey soil



PREPARED BY: Jim Brac

INTERNATIONAL TECHNOLOGY CORPORATION

DATE	08 1 1 9 0
TIME	1 3 3 0
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PROJECT NO.	446493

SAMPLE COLLECTION LOG

PROJECT NAME Whirlpool Amert

SAMPLE NO. SS-9 (Resample)

SAMPLE LOCATION Amert

SAMPLE TYPE Soil

COMPOSITE ___ YES ✓ NO

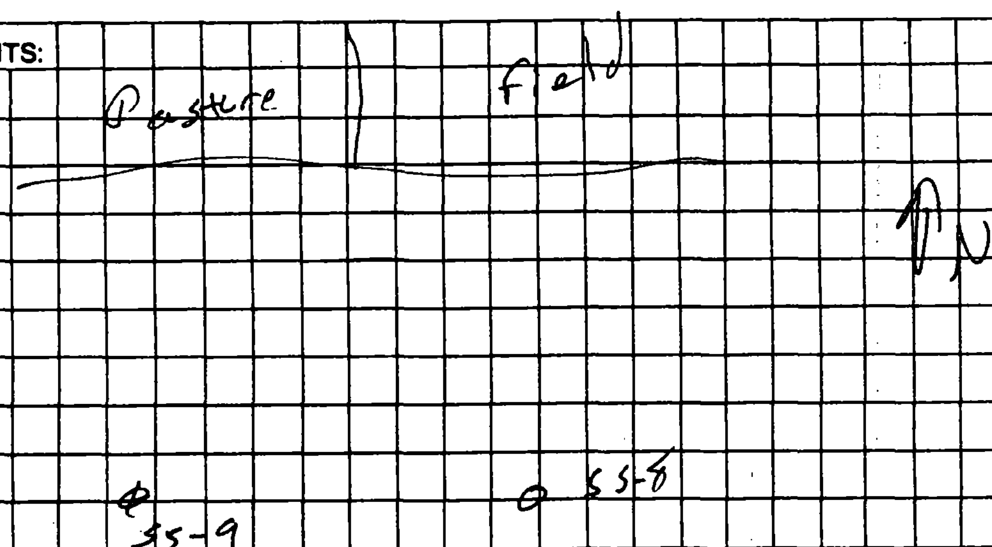
COMPOSITE TYPE —

DEPTH OF SAMPLE 6-12 in

WEATHER Hot ptly cloudy

CONTAINERS USED	AMOUNT COLLECTED
250ml	full

COMMENTS:



PREPARED BY: Jim Brae

INTERNATIONAL TECHNOLOGY CORPORATION

DATE	08 11 90
TIME	1500
PAGE	1 OF 1
PAGE	
PROJECT NO.	446493

SAMPLE COLLECTION LOG

PROJECT NAME: Whirlpool Amert

SAMPLE NO.: SS-10, SS-11, SS-12 (Resample)

SAMPLE LOCATION: Amert Background in Cornfield

SAMPLE TYPE: Soil

COMPOSITE ____ YES ✓ NO

COMPOSITE TYPE: —

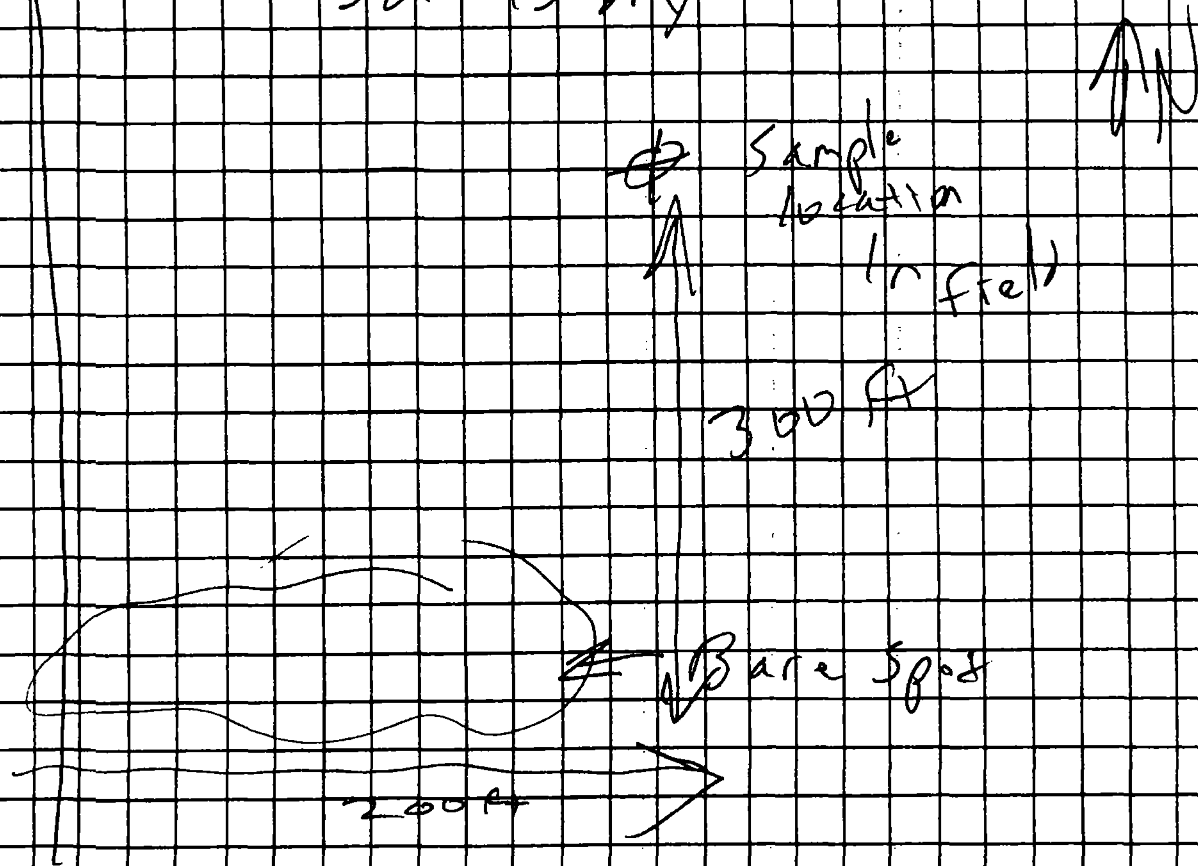
DEPTH OF SAMPLE: SS-10: 6-12in | SS-11: 12-18" | SS-12: 18-24in

WEATHER: hot ptly cloudy

CONTAINERS USED	AMOUNT COLLECTED
250ml	full

COMMENTS:

Soil is Dry



PREPARED BY: Jim Bra[illegible]

INTERNATIONAL TECHNOLOGY CORPORATION

DATE	08 11 90
TIME	14 10
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PROJECT NO.	446496

SAMPLE COLLECTION LOG

PROJECT NAME: Whirlpool Amert

SAMPLE NO.: SS-13, SS-14, SS-15 (Resample)

SAMPLE LOCATION: Amert, corn field

SAMPLE TYPE: soil

COMPOSITE ___ YES ✓ NO

COMPOSITE TYPE: —

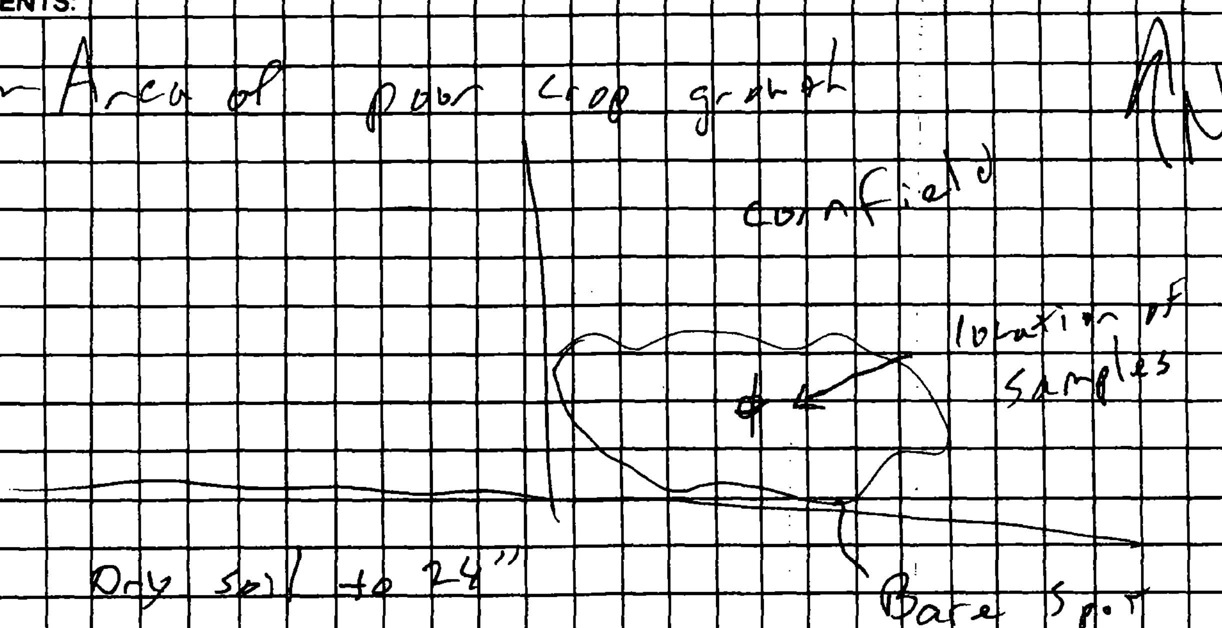
DEPTH OF SAMPLE: SS-12: 6-12 in | SS-13: 12-18 in | SS-14: 18-24 in

WEATHER: hot, ptly cloudy

CONTAINERS USED	AMOUNT COLLECTED
250ml	full

COMMENTS:

from Area of poor crop growth



Dry soil to 24"

Brown sandy clay to 7"
reddish tan fine sand 7"-18"
grey sandy clay below 18

PREPARED BY: Jim Bra[illegible]

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DATE	0 8 1 1 9 0
TIME	1 3 4 0
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PROJECT NO.	446493

SAMPLE COLLECTION LOG

PROJECT NAME: Whirlpool Amert

SAMPLE NO.: SS-17 (resample)

SAMPLE LOCATION: Amert West "Discharge" area - "Background"

SAMPLE TYPE: Soil

COMPOSITE ___ YES ✓ NO

COMPOSITE TYPE: —

DEPTH OF SAMPLE: 6-12 in

WEATHER: hot ptly cloudy

CONTAINERS USED	AMOUNT COLLECTED
250ml	full

COMMENTS:

Soil dry

PREPARED BY: Jim Brace

INTERNATIONAL TECHNOLOGY CORPORATION

DATE	08/11/90
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PAGE	1 OF 1
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PROJECT NO.	446493

SAMPLE COLLECTION LOG

PROJECT NAME Whirlpool Amert

SAMPLE NO. SS-~~16~~ 18

SAMPLE LOCATION Amert East drainage area "Background"

SAMPLE TYPE soil

COMPOSITE ____ YES ✓ NO

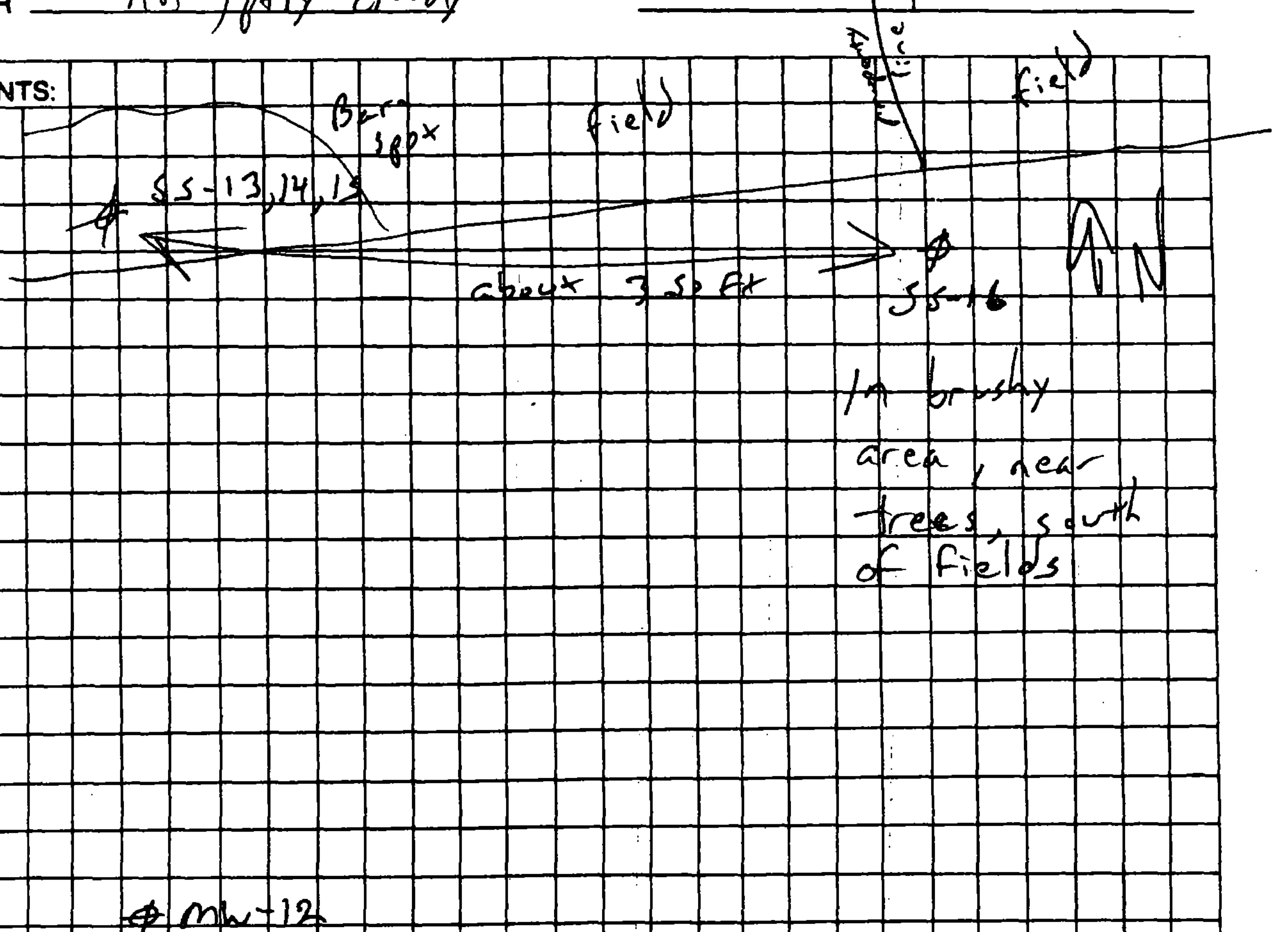
COMPOSITE TYPE —

DEPTH OF SAMPLE 6-12 in

WEATHER hot, ptly cloudy

CONTAINERS USED	AMOUNT COLLECTED
250ml	full

COMMENTS:



In brushy area, near trees, south of fields

PREPARED BY: Jim Brow